Introduction to the Energy Imbalance Market

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Lead Client Trainer

The topics that will be covered

- Introduction
- Key players
- Responsibilities
- The EIM process
- Implementation timeline
- Governance

INTRODUCTION

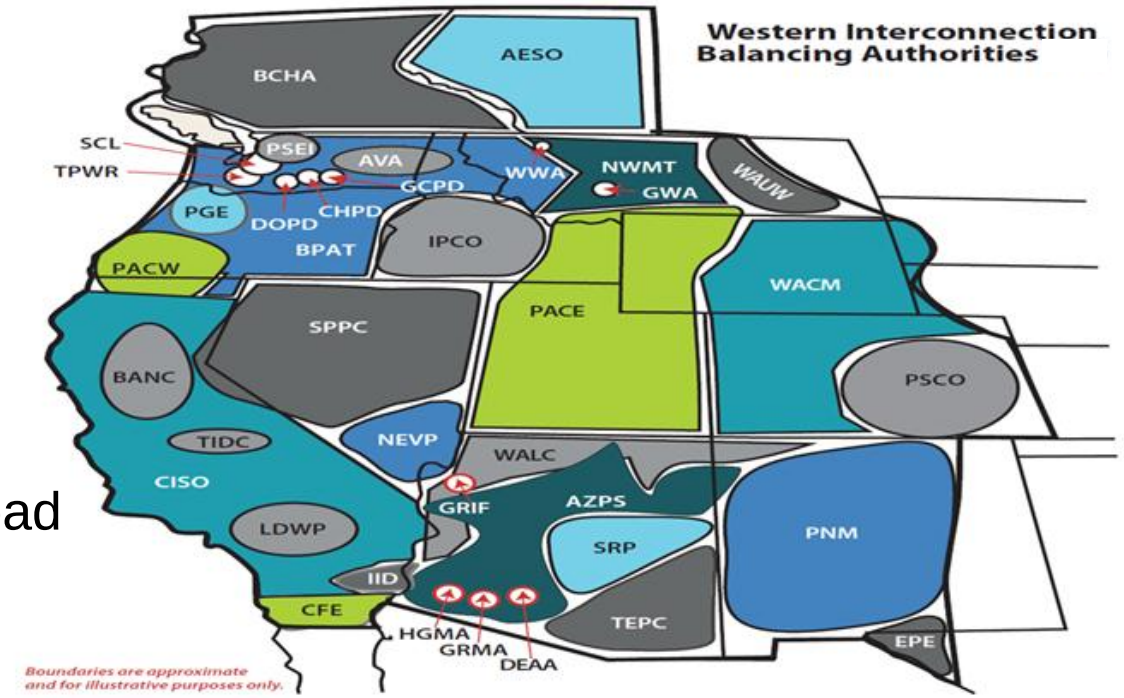
What is the Energy Imbalance Market?

A balancing authority (BA) is responsible for operating a transmission control area.

It matches generation with load and maintains electric frequency of the grid.

There are 37 balancing authorities in the western interconnection.

Today, each BA balances load and generation separately from other BAs.



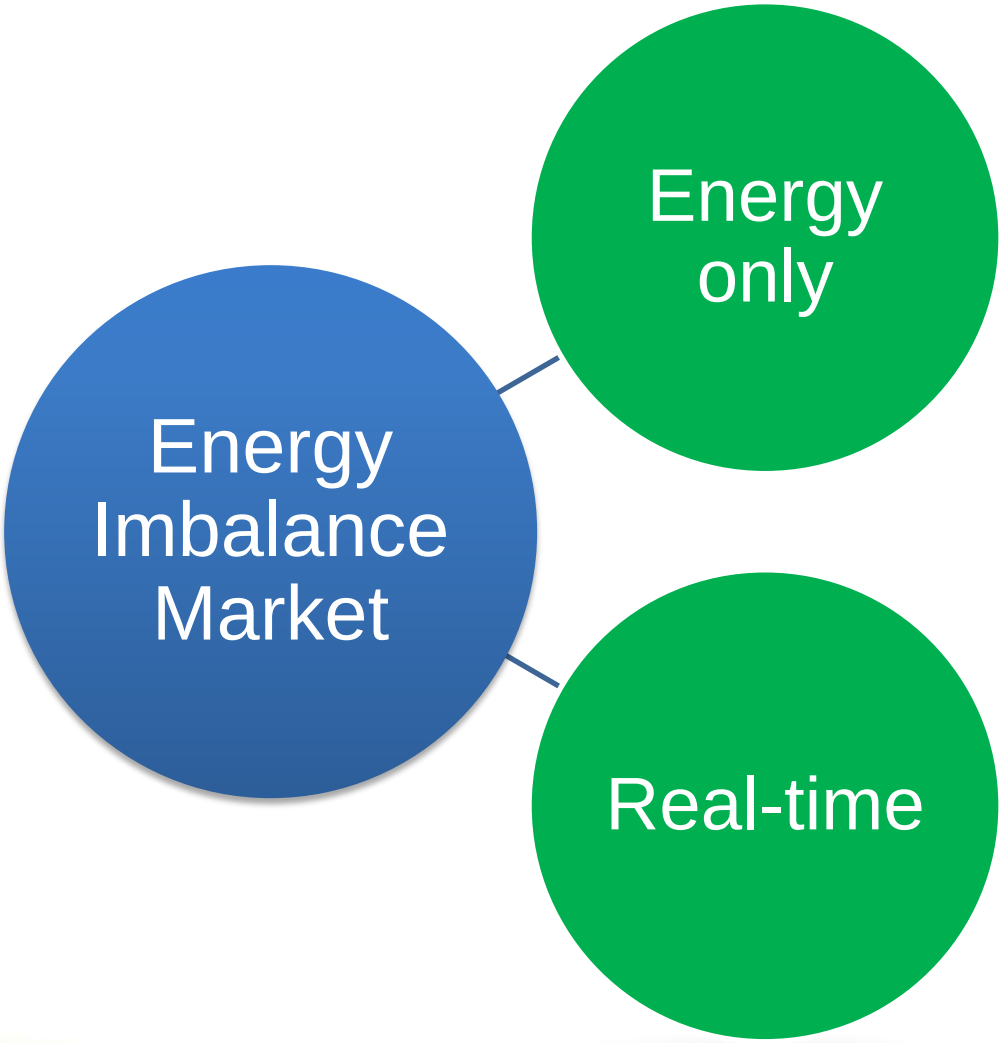
Energy Imbalance Market

Energy – The electrical power produced or supplied by a generating resource

Imbalance – A situation where supply does not equal demand

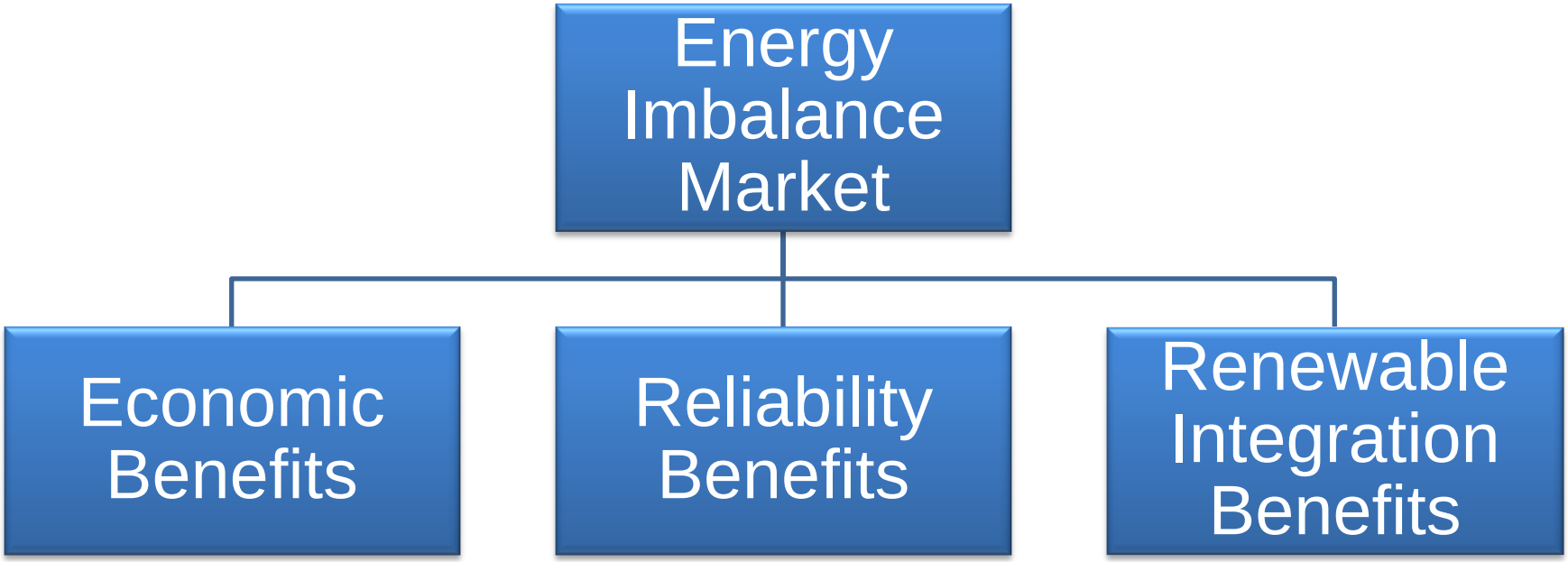
Market – A method of resolving energy imbalance through submission and clearing of energy schedules and bids

Key concepts



- No ancillary services

- 15 minute market
- 5 minute market


Energy Imbalance Market
Economic Benefits
Reliability Benefits
Renewable Integration Benefits

What's not part of EIM?

- Balancing Authorities' responsibility for maintaining NERC and WECC requirements will not change
- EIM deals only with energy, not ancillary services or reserves
- EIM does not change the process for existing bilateral transactions or day-ahead transactions with the ISO

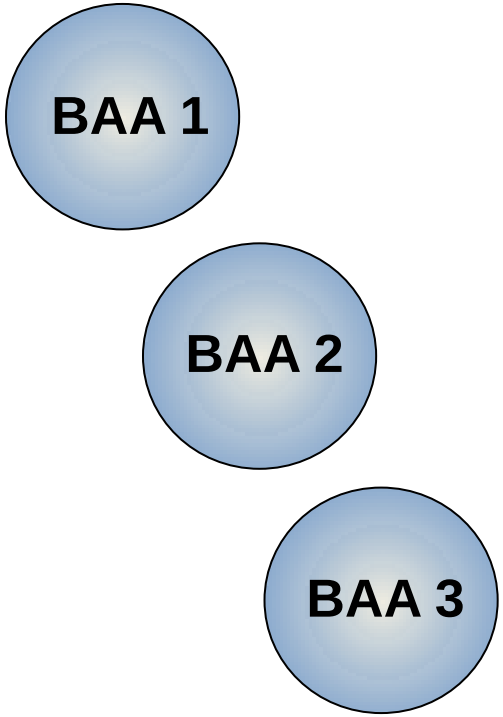
WHAT ARE THE BENEFITS OF EIM?

Real-time visibility, geographical diversity, automated dispatch, enhanced reliability, renewable integration, least cost dispatch…

Benefits

- EIM provides both reliability and economic benefits
- EIM implementation helps facilitate renewable integration
- Based on an existing platform, the ISO provides a flexible and scalable approach to EIM

Today each hour each balancing authority maintains load/generation balance by manually dispatching its own resources and maintaining extra reserves.

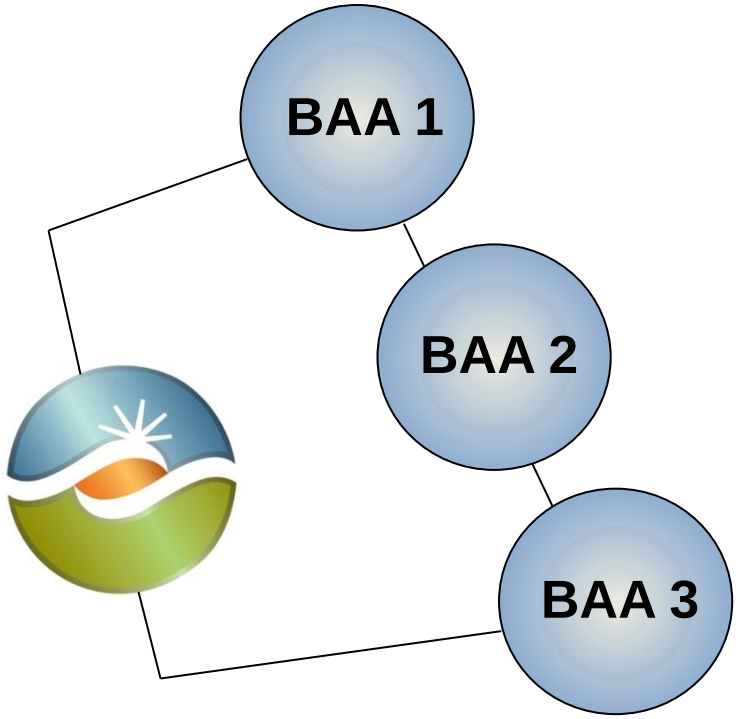


Each BA examines their load/resource imbalance

They manually dispatch resources from within their BAA to resolve the imbalance

They do not have the benefit of other BA's resources to help with the imbalance

EIM resolves imbalances in real-time more efficiently through an automated 5 minute multi-BAA energy dispatch service.



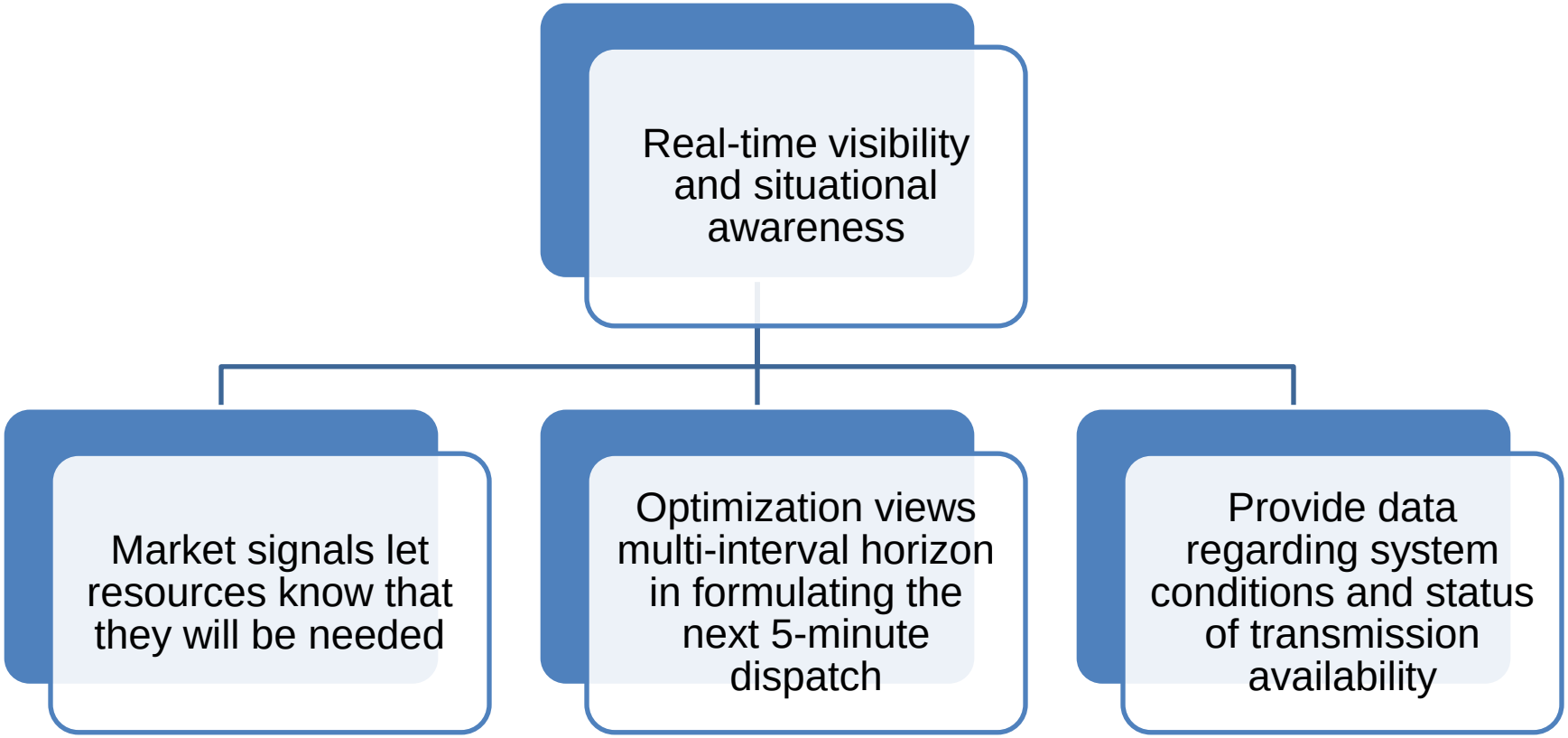
All resources in the EIM footprint are visible, even if not available for EIM dispatch

The real-time EIM optimization will efficiently dispatch participating resources to maintain balance

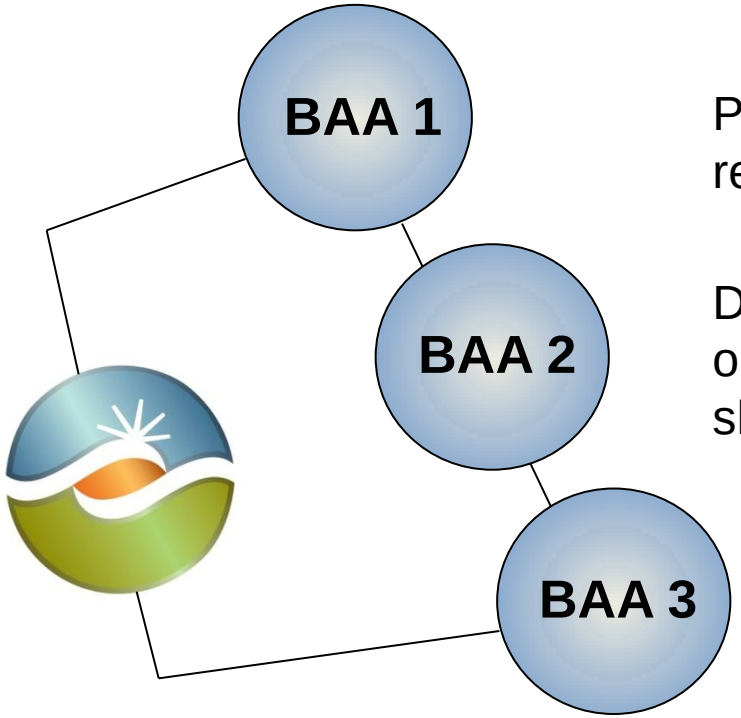
The real-time market looks ahead at the situation in upcoming intervals

Prior to each dispatch the EIM will automatically assess the entire footprint and determine the most effective dispatch

With all of this information on hand, EIM allows proactive resolution of potential reliability issues.



Example of real-time visibility and situational awareness



Prior to the beginning of the hour all load and resources are balanced

During the hour there is a forced generation outage in BAA 2, creating a significant supply shortfall.

Generators from other BAAs that have placed bids in the market for their generation may be effective in relieving the imbalance in BAA 2

A wider portfolio of resources to maintain system balance could reduce the quantity of reserves that are needed.

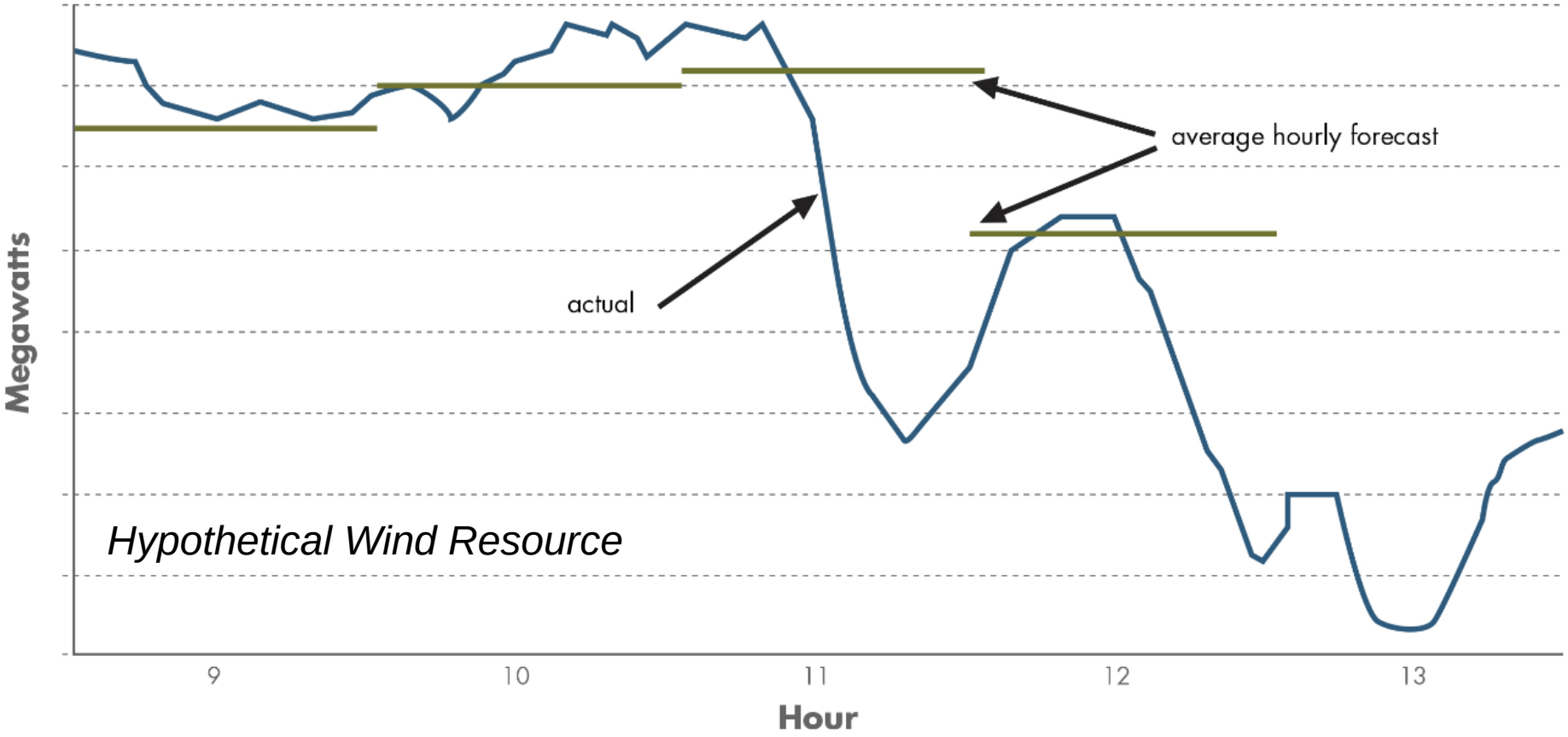
Without EIM

- Available resources are within the BAA
- Must maintain extra generation on hand in the event they may be needed to resolve an imbalance

With EIM

- Available resources are within EIM footprint
- The 5 minute market automatically procures generation needed to meet future imbalances

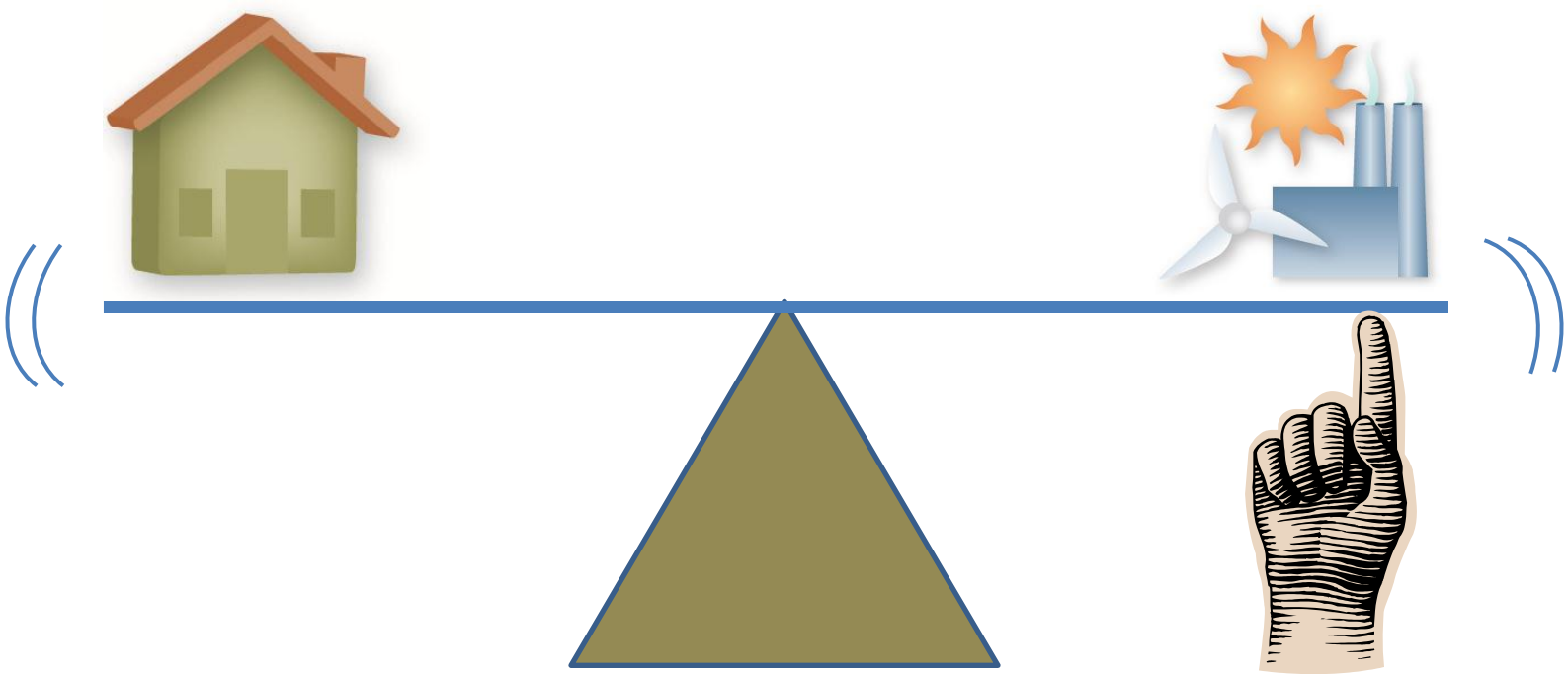
EIM allows the ability to more closely follow variable energy resources



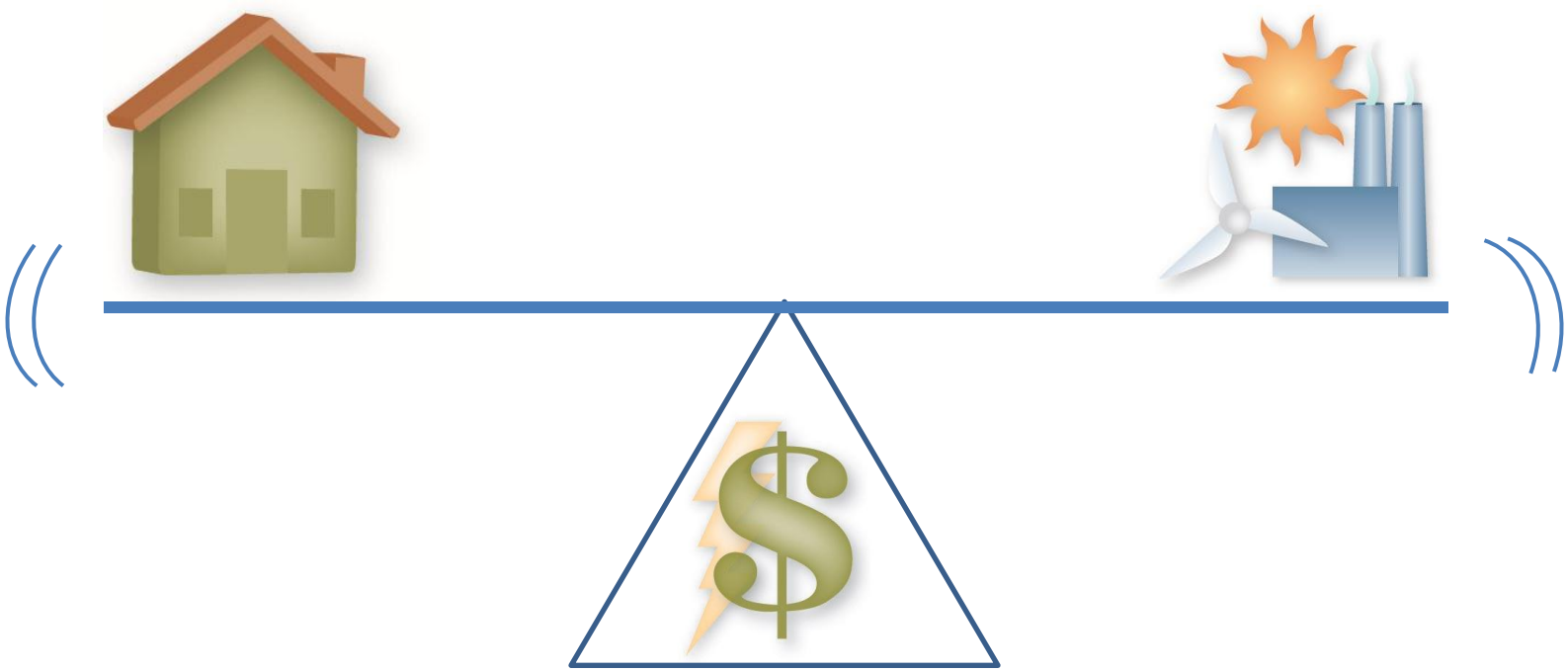
WHAT WILL CHANGE?

Changes for each type of affected entity.

Balancing authorities balance load with generation.



The energy imbalance market provides a more efficient method for maintaining balance.



Key players

What are their roles?

Energy Imbalance Market has key definitions

EIM Entity is a balancing authority, representing one or more EIM Transmission Service Providers that make transmission available to EIM, that enables the EIM to occur in its balancing authority area (BAA). By enabling the EIM, real-time load and generation imbalances within its BAA will be settled through the EIM.

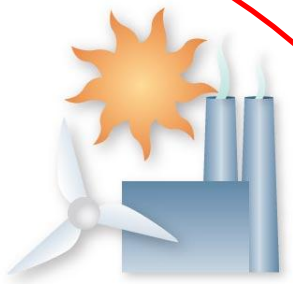
- EIM Entity determines eligibility of resource types, and required transmission service, within its BAA. (15-minute economic bids on its interties? Dynamic transfers?)

EIM Participating Resource is a resource located within the EIM Entity BAA that is eligible and elects to participate in the EIM.

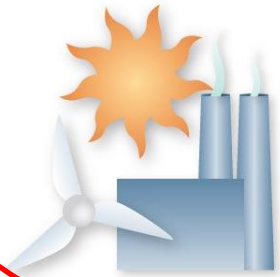
- In the 5-minute market, eligible resources may include generators, participating loads & demand response, non-generator resources, and dynamic transfers.
- In the 15-minute market, imports and exports may also be eligible.

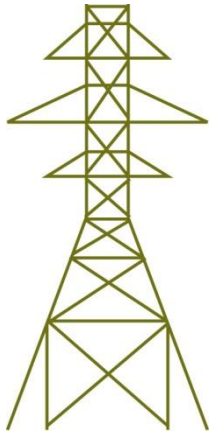
Balancing Authority→**EIM Entity**

Market Operator

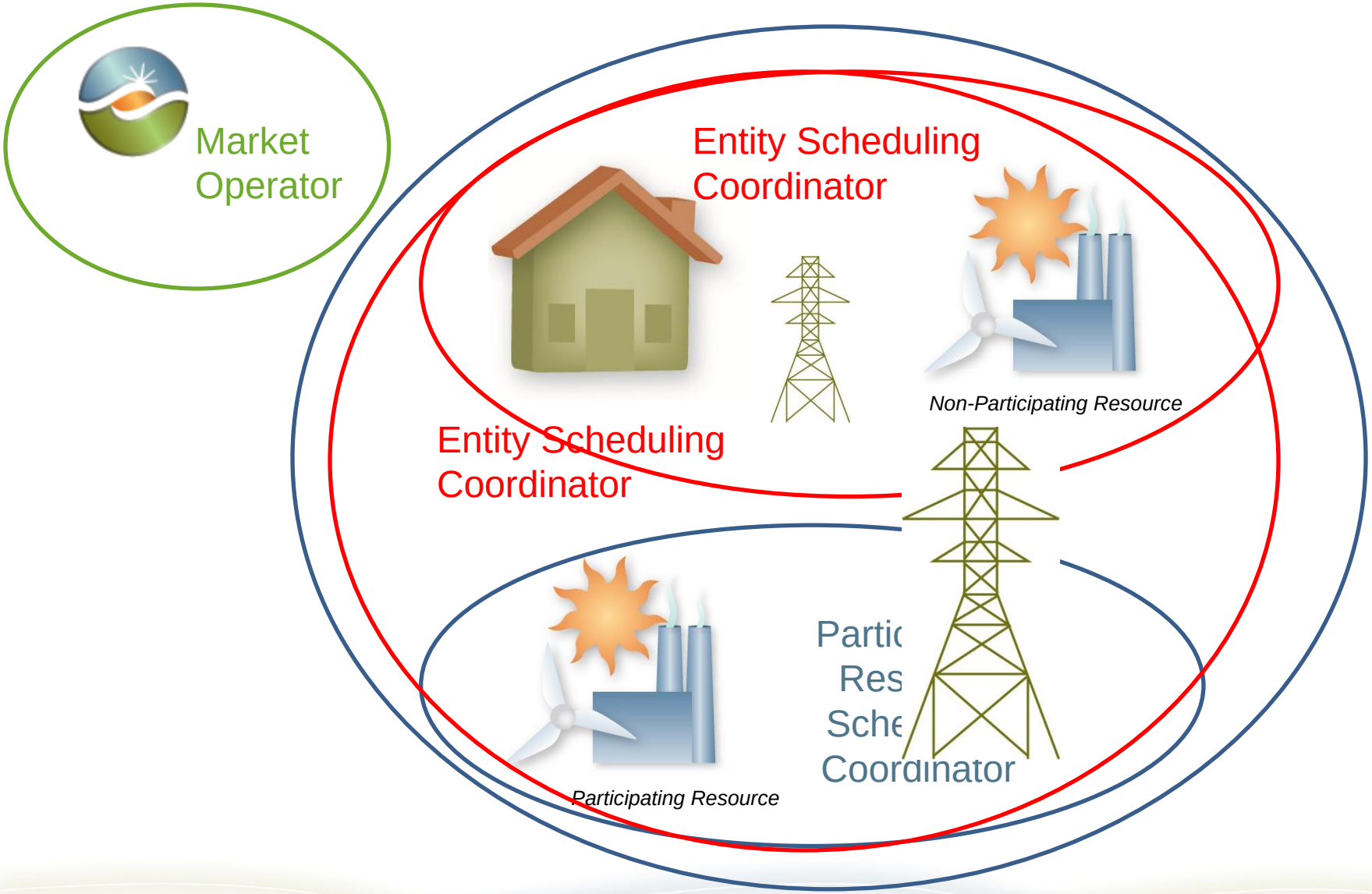


Entity Scheduling Coordinator





Balancing Authority→**EIM Entity**



EIM Entity

A balancing authority area that is enabling EIM to occur in their area, thereby allowing real-time load and generation imbalances to be settled through EIM.

Market Operator

The California ISO is the market operator. It is responsible for running and settling the energy imbalance market.

Participating Resource

A resource located within a EIM Entity that elects to participate in the EIM. Through their participating resource scheduling coordinator, these resources submit bids to the market operator which convey their availability in the real-time market.

Non-Participating Resource

A resource located within a EIM Entity that chooses not to make its resource available for dispatching in the real-time market. The entity scheduling coordinator must ensure that these resources are accounted for when determining balanced base schedules.

Participating Resource Scheduling Coordinator

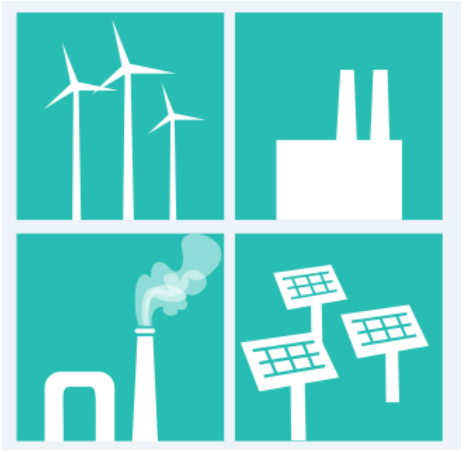
An entity certified by the ISO that submits economic bids and is responsible for financial settlements for one or more participating resources.

Entity Scheduling Coordinator

An entity certified by the ISO that will coordinate and facilitate the energy imbalance market for one or more EIM Entities. They are responsible for resource plans and financial settlements on behalf of these non-participating resources and loads.

There are other steps in the EIM implementation process. For example:

Agreements



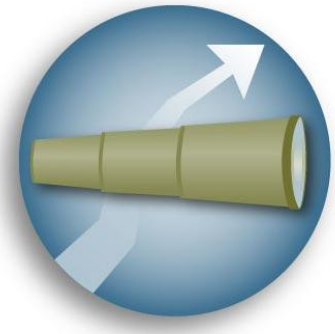
Resource parameters

Metering

Modeling

Responsibilities

Forecasts, Base Schedules, Resource Plans



Demand Forecast

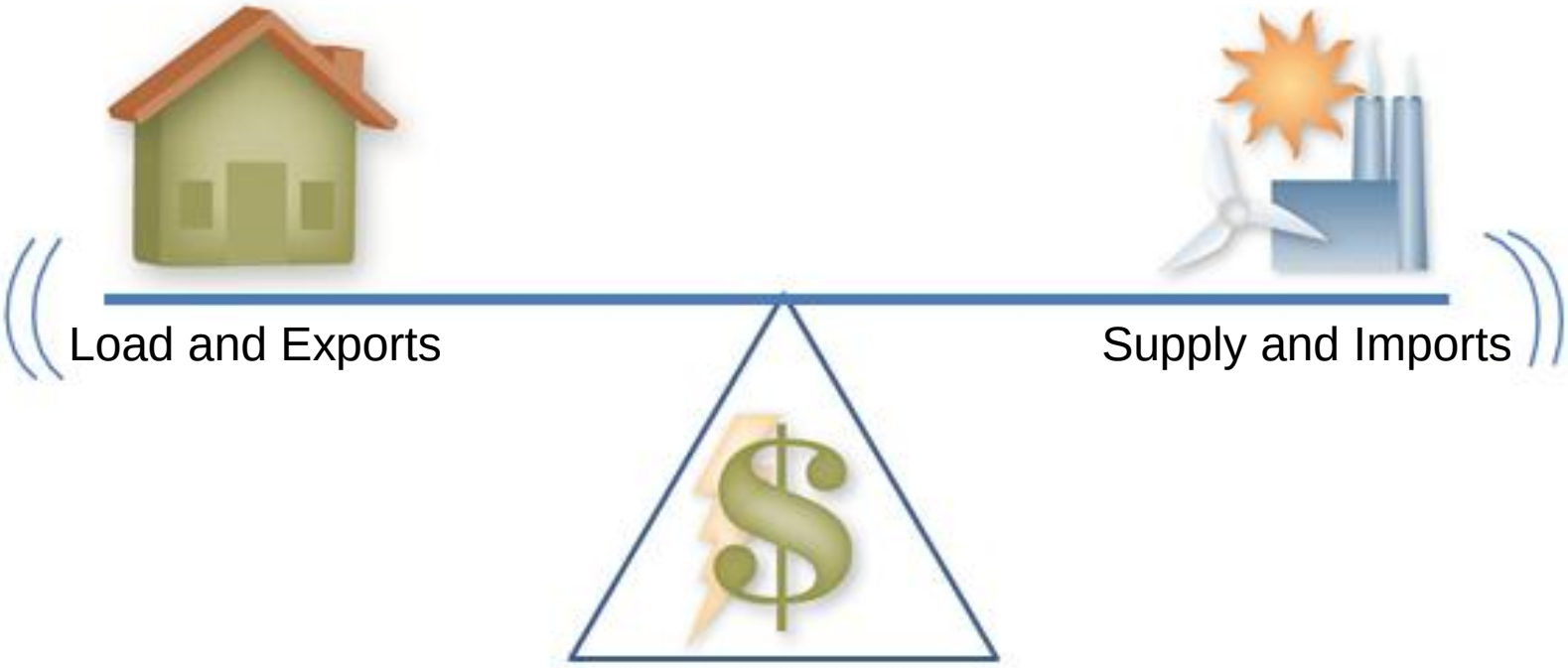
Used to determine the amount of supply that will be needed. The ISO forecasts demand:

- 5 minute forecasts up to a 4.5 hour horizon, and;
- Hourly forecasts for the next 7 days

Base Schedule

A forward energy schedule; includes hourly forecasts of load, hourly generation schedules and hourly interchange schedules. It is used as a baseline for financial settlements.

Base schedules will balance supply and demand.

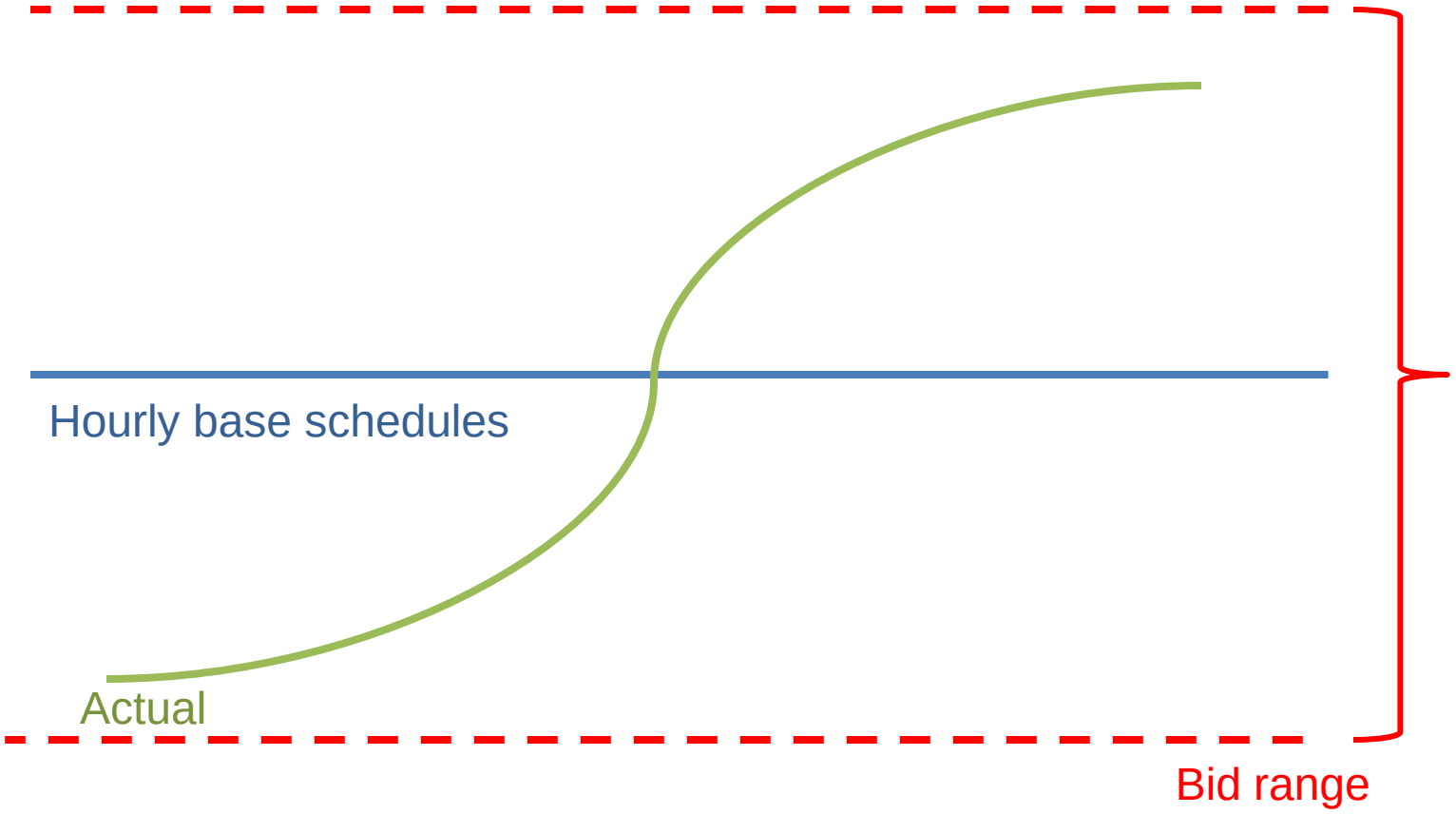


Resource Plan

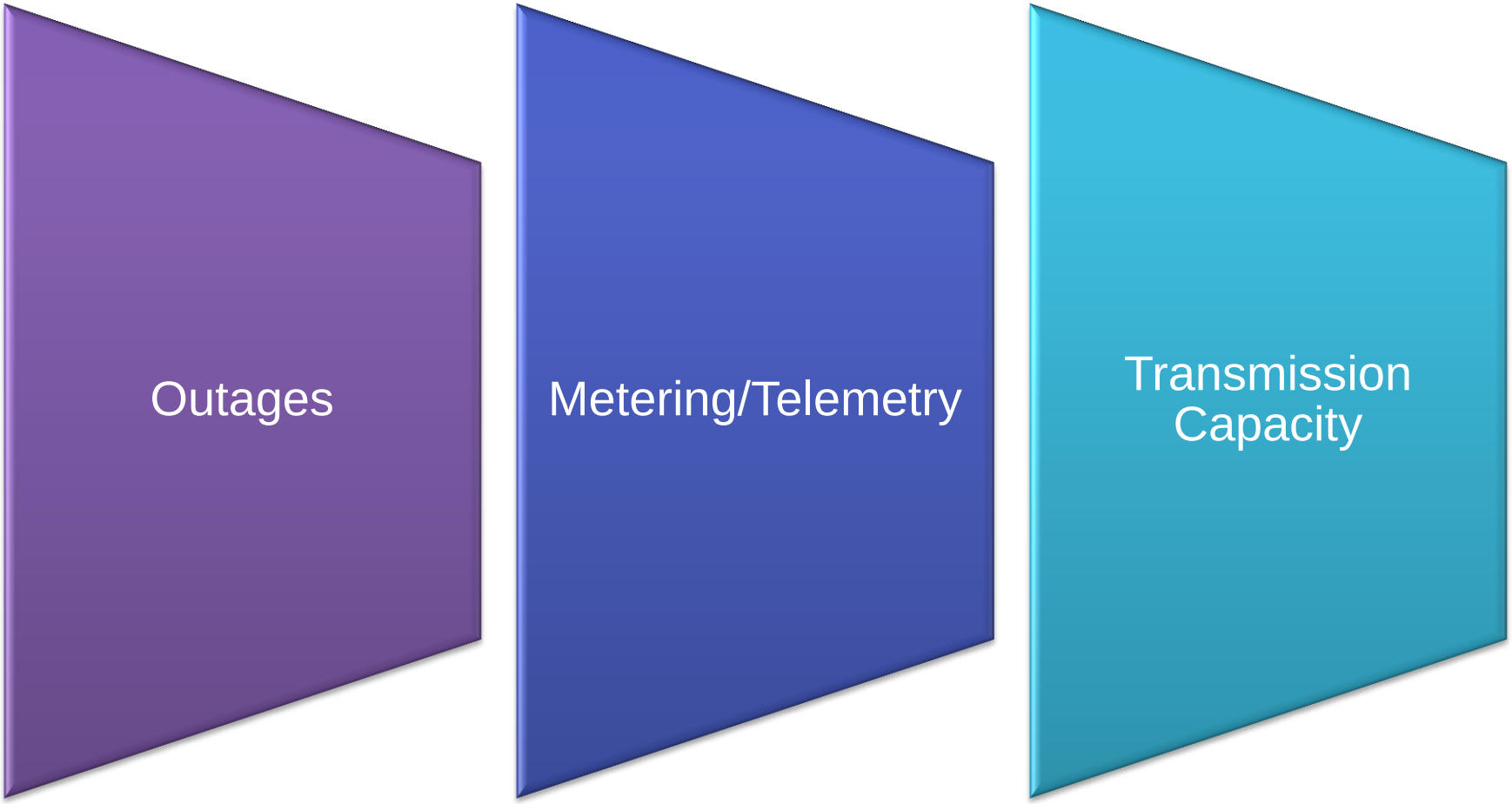
Needed to balance supply and demand and evaluate resource sufficiency. Comprised of:

- Load, generation and interchange base schedules
- Energy bids from participating resources
- Ancillary service plans

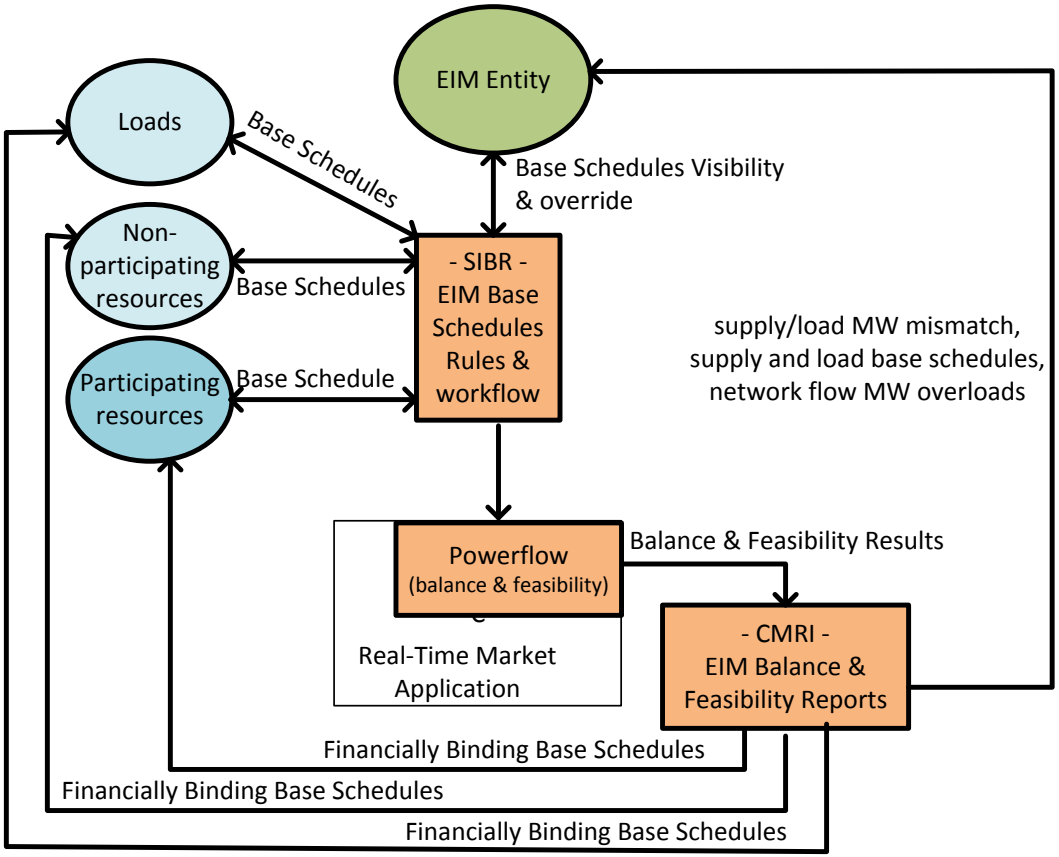
A resource plan ensures the balance, feasibility and flexibility of all of its base schedules



Along with forecasts, base schedules and resources plans, current operational characteristics are also needed.



EIM design includes functionality to submit base schedules and review/approve resource plans



EIM Entity Scheduling Coordinator has full visibility of all base schedules at all times.

The EIM process

What happens each day?

EIM builds on FERC Order 764 for financially binding 15-minute functions in real-time market

CAISO

Day Ahead Schedule

15-Minute Unit Commitment & Energy Schedule, and Incremental AS Awards

Real-Time Dispatch

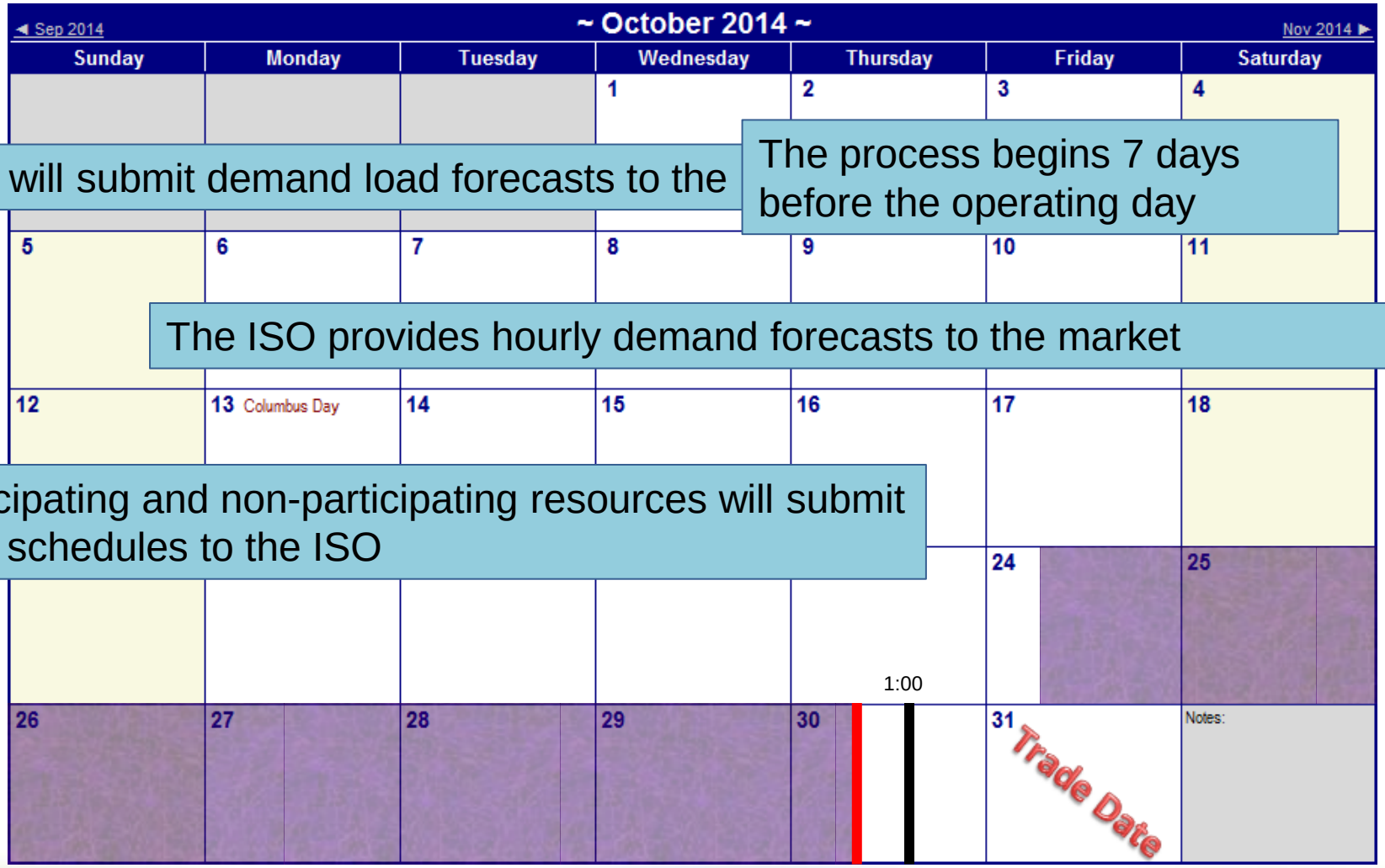
EIM

Base Schedule (basis of financial settlement)

15-Minute Unit Commitment & Energy Schedule

Real-Time Dispatch

Let's look at the EIM process for one operating day – October 31, 2014 for example.



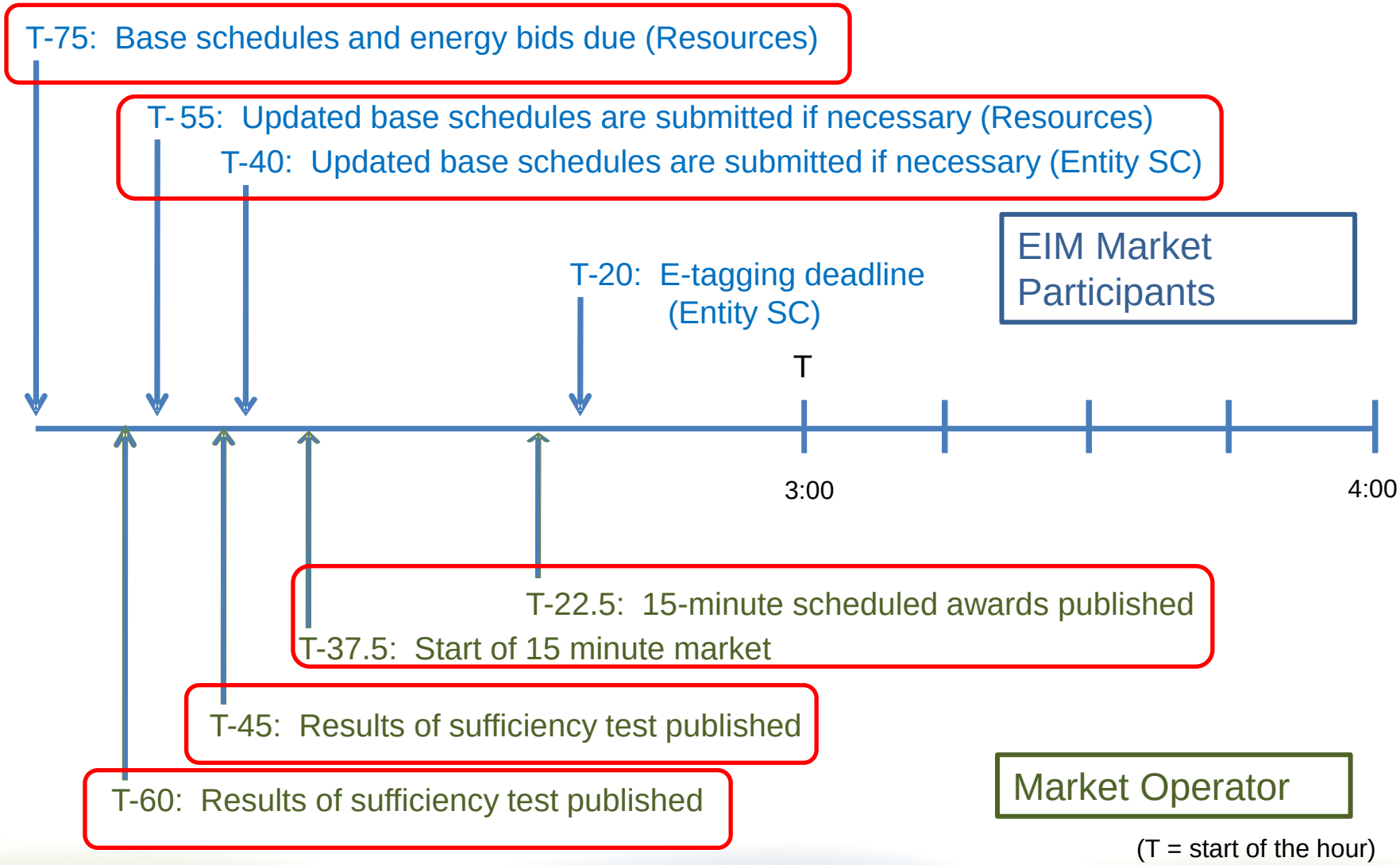
ESC will submit demand load forecasts to the

The process begins 7 days before the operating day

The ISO provides hourly demand forecasts to the market

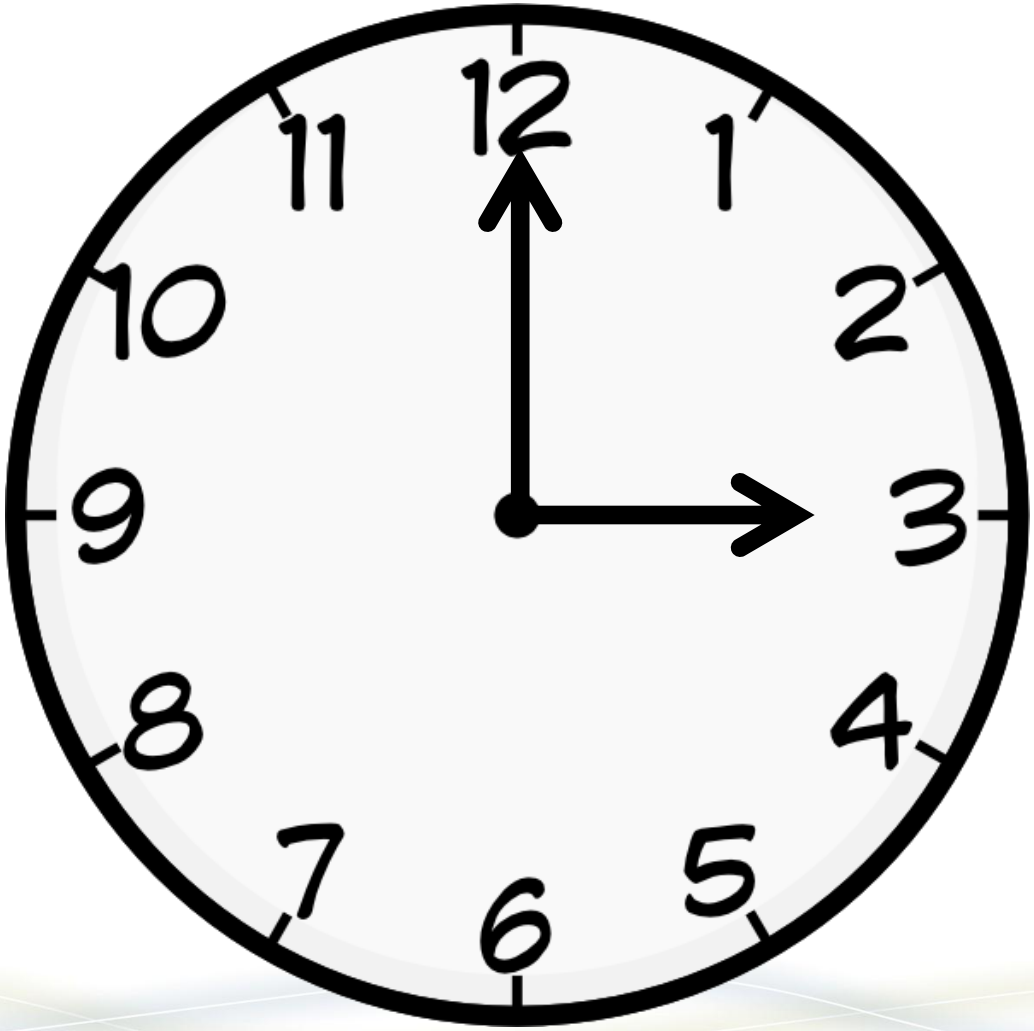
Participating and non-participating resources will submit base schedules to the ISO

Steps leading up to the operating hour

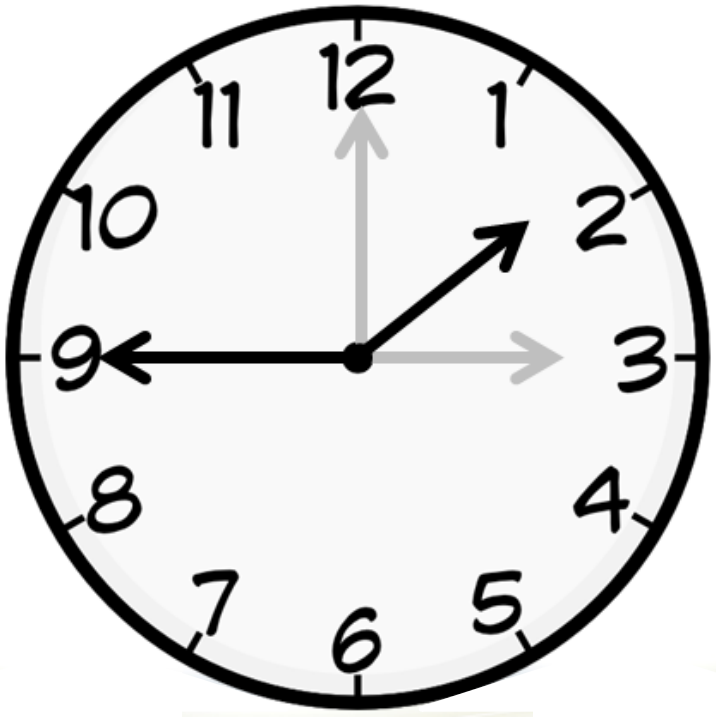


(T = start of the hour)

There are processes that occurs in advance of the market run for each hour. Let's use 3:00 pm as an example.



The first milestone is at 75 minutes before the operating hour.

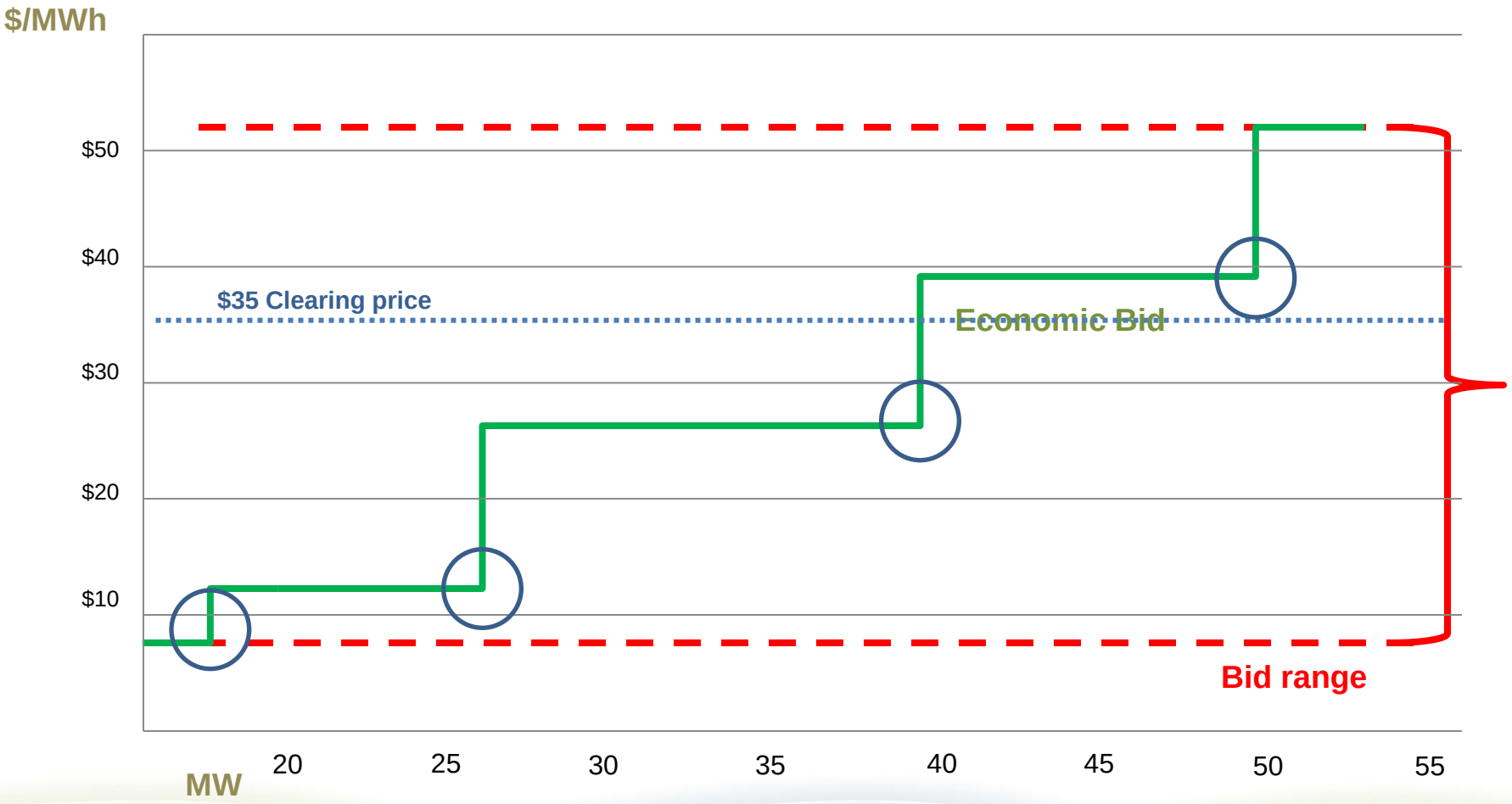


T-75

By 1:45 pm,

- Initial base schedules are due
  - Non-participating resources
  - Participating resources
  - Inter-tie schedules
- Energy bids are due
  - Participating resources

Energy bids provide the ability to cover fluctuations in load.

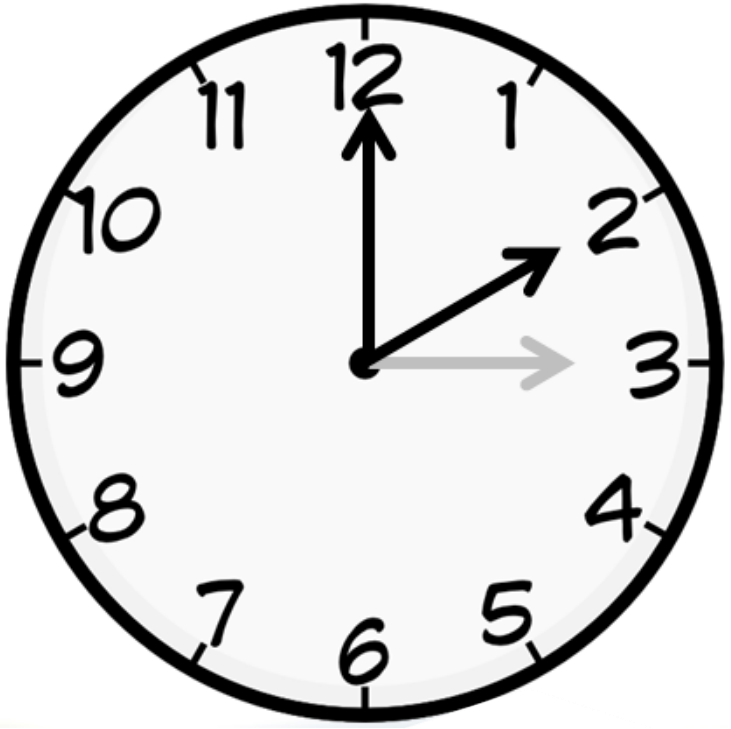


Components of the LMP for EIM Entities

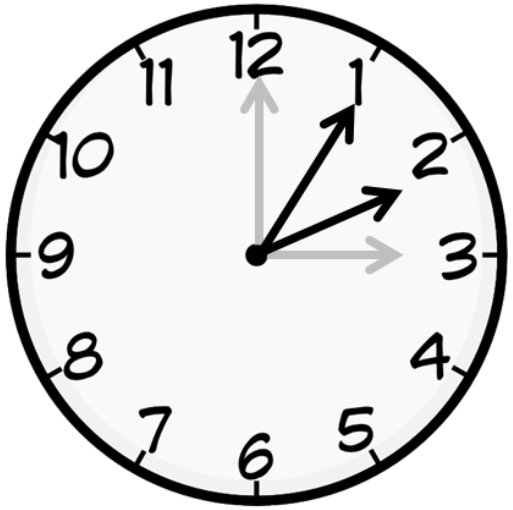
The ISO will notify the ESC of the results of the sufficiency test within 15 minutes.

At 2:00 pm

- Status of sufficiency test:
  - Balanced load and generation?
  - Free of congestion?
  - Sufficient ramping capability?

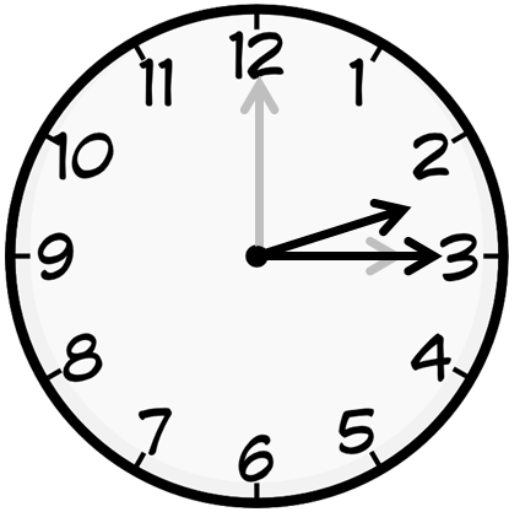


T-60



T-55

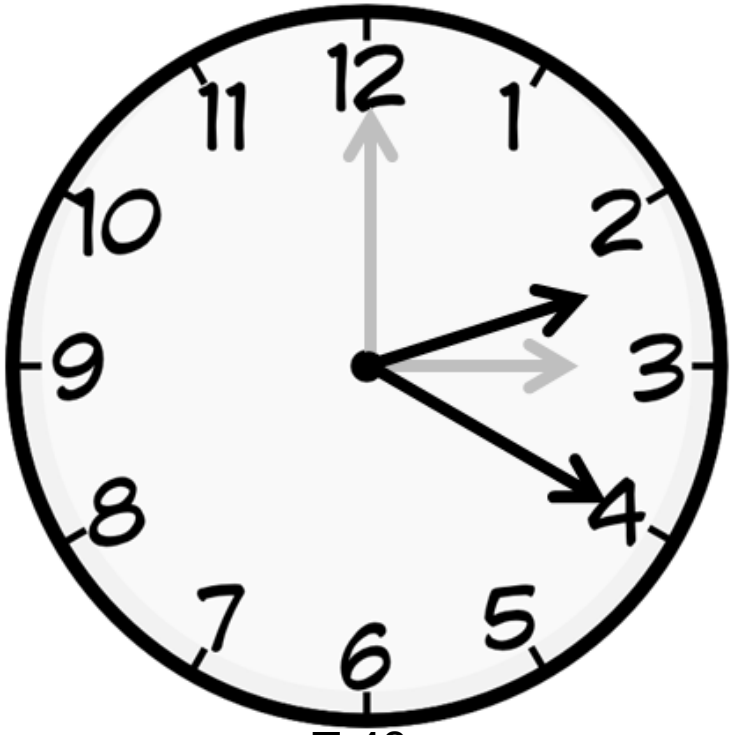
If necessary, the resources must resubmit the base schedules by 2:05 pm.



T-45

The ISO will conduct another test and provide the results to the ESC by 2:15 pm.

The ESC submits updated base schedules to finalize the resource plan to address any issues identified by the ISO.



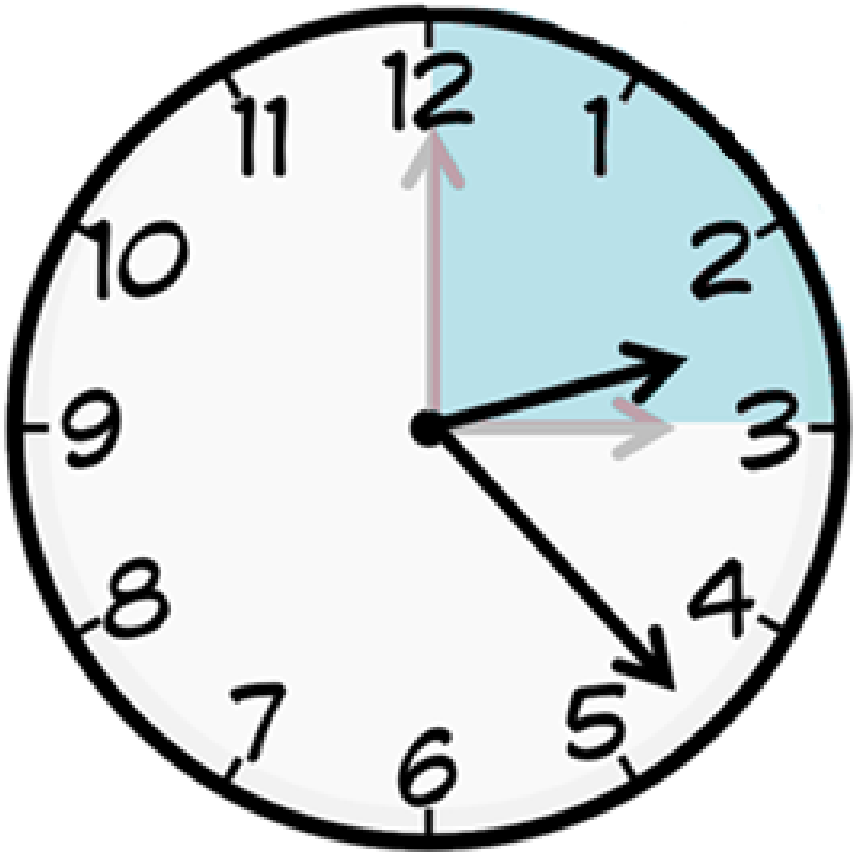
T-40

These final base schedules will be used in the financial settlement process.

Now the 15-minute market will run for the first fifteen minute interval of the hour.

Market inputs:

- Load forecast
- Variable energy forecast
- Energy bids
- Generation outages
- Transmission outages
- Dynamic contingencies



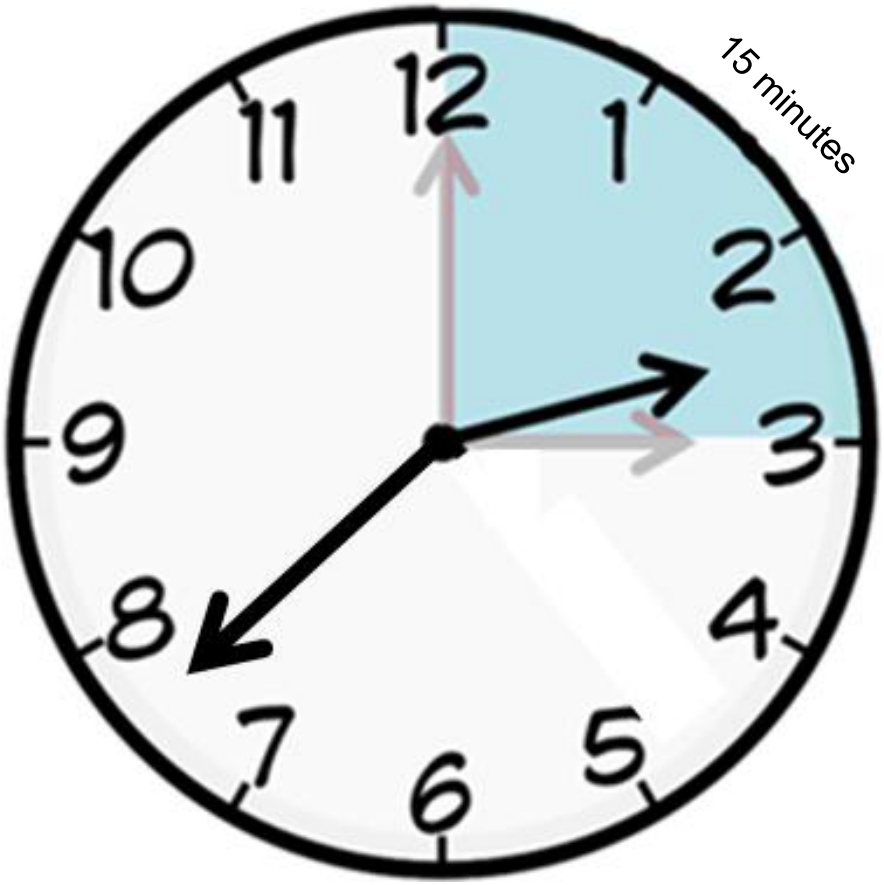
T-37.5

At 2:38, the results of the 15-minute market will be published.

Market outputs:

- generation schedules
- 15 minute prices

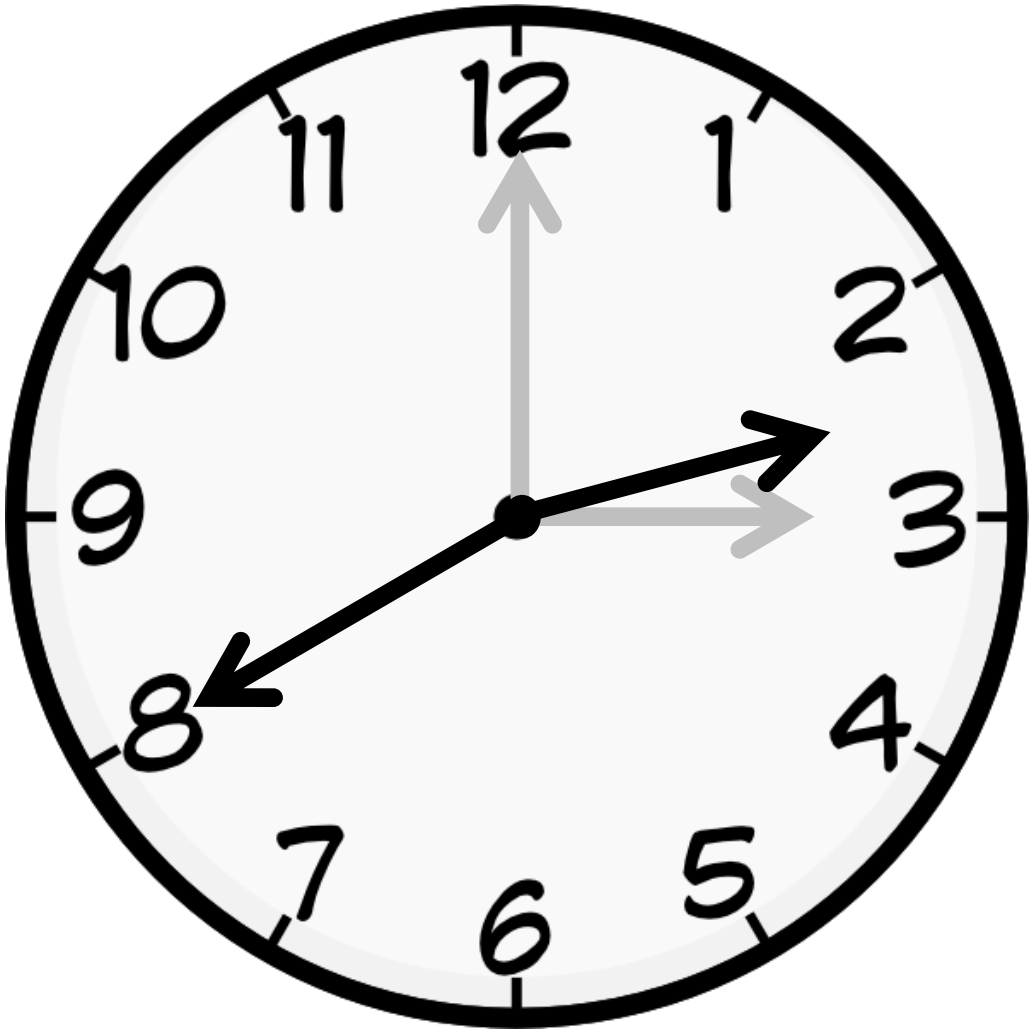
for the 3:00 pm to 3:15 pm interval.



T-22.5

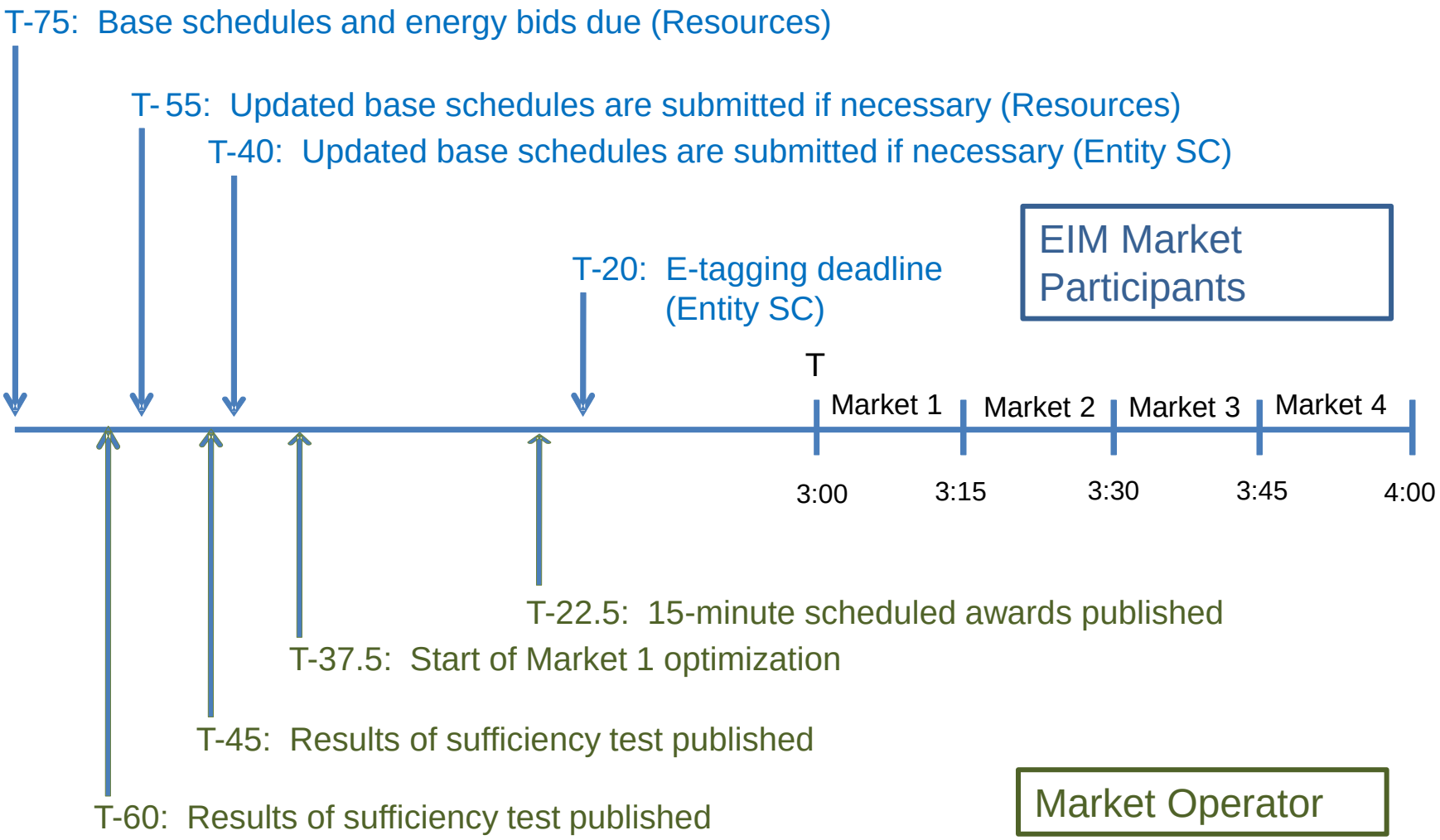
The ESC will submit E-tags, per NERC/WECC requirements.

2:40 - E-tag deadline
- Static imports
- Exports



T-20

Milestones for 3:00 – 3:15 (Market 1)

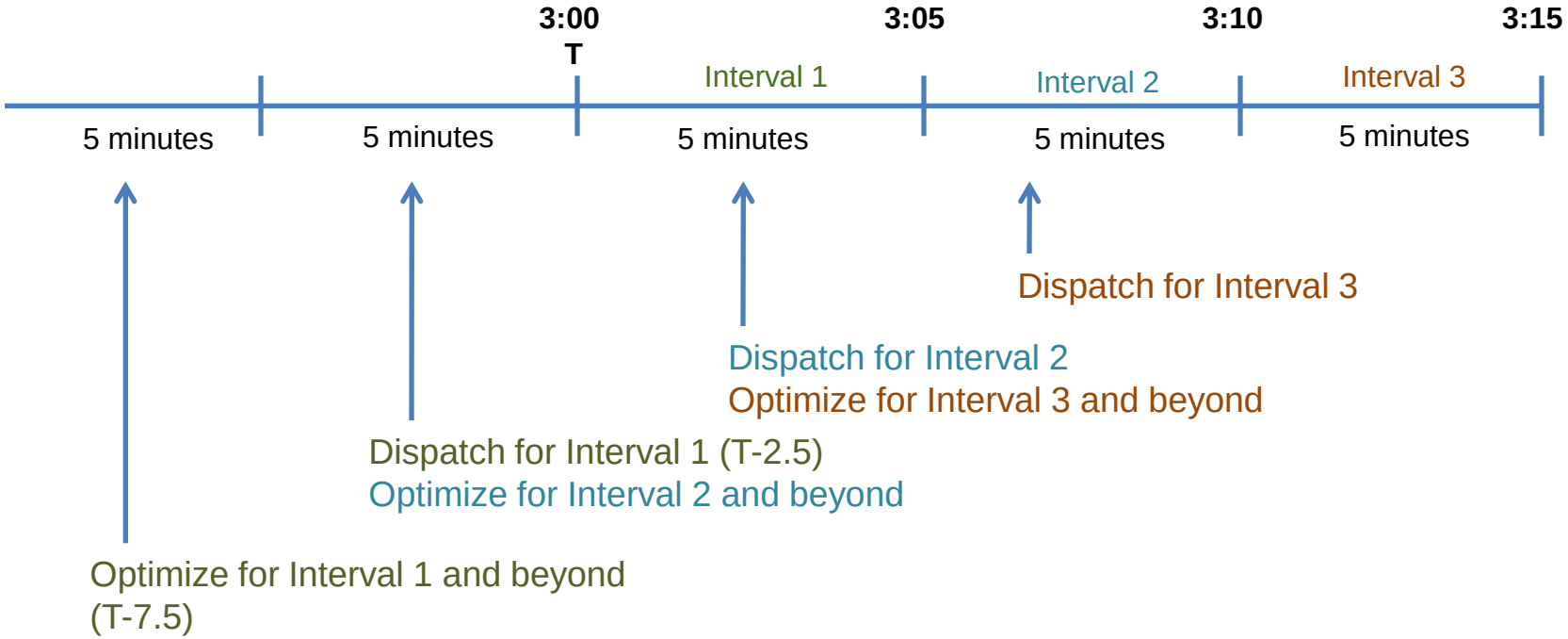


(T = start of the hour)

Timeline: Dispatch for 5-minute interval and beyond works together with 15-minute market

Look-ahead horizons:

- 15-minute market optimization looks ahead up to 4.5 hours
- 5-minute market optimization looks ahead up to 65 minutes



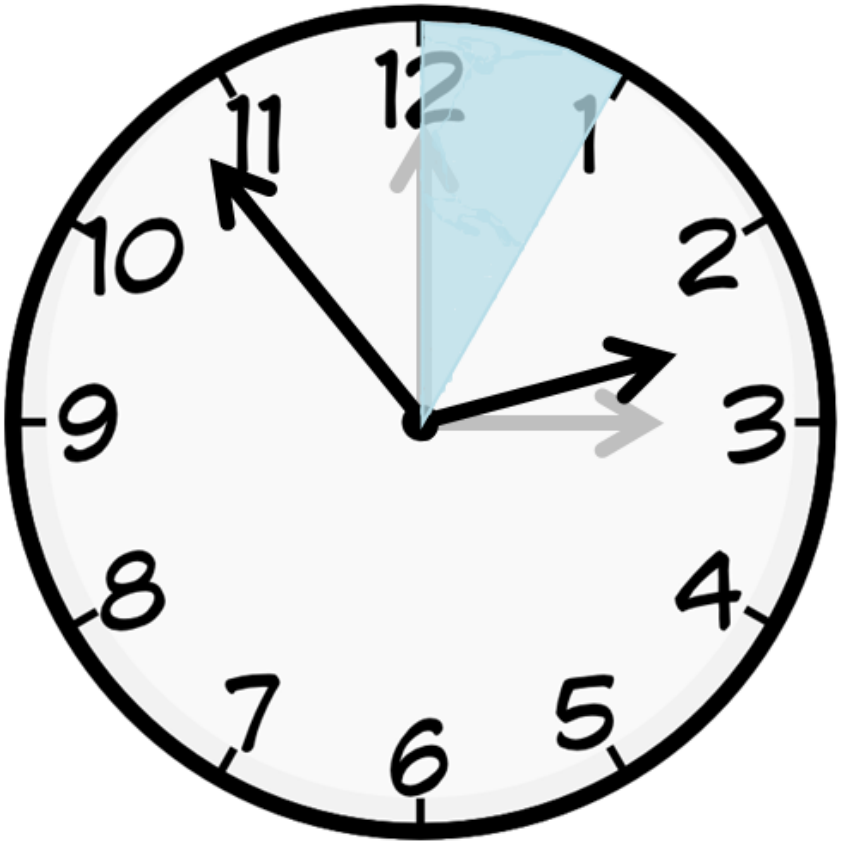
EIM's congestion management is a parallel process to the Unscheduled Flow Mitigation Plan

- EIM will not manage constraints outside its market area
  - BPA Transmission for EIM will be subject to the rules of BPA
  - Existing processes remain available to path operators

- EIM will manage congestion on transmission made available through EIM Entities, and notify them if available bids cannot resolve congestion
  - EIM Entities then determine further steps, as done now (also applies to CAISO management of COI)
  - EIM Entities may act before EIM exhausts bids
  - EIM will adjust its schedules for UFMP or other manual dispatch

- Provisions are in EIM tariff (29.7(i)), and agreements with EIM participants' transmission providers as needed

Beginning of the 5-minute dispatch interval

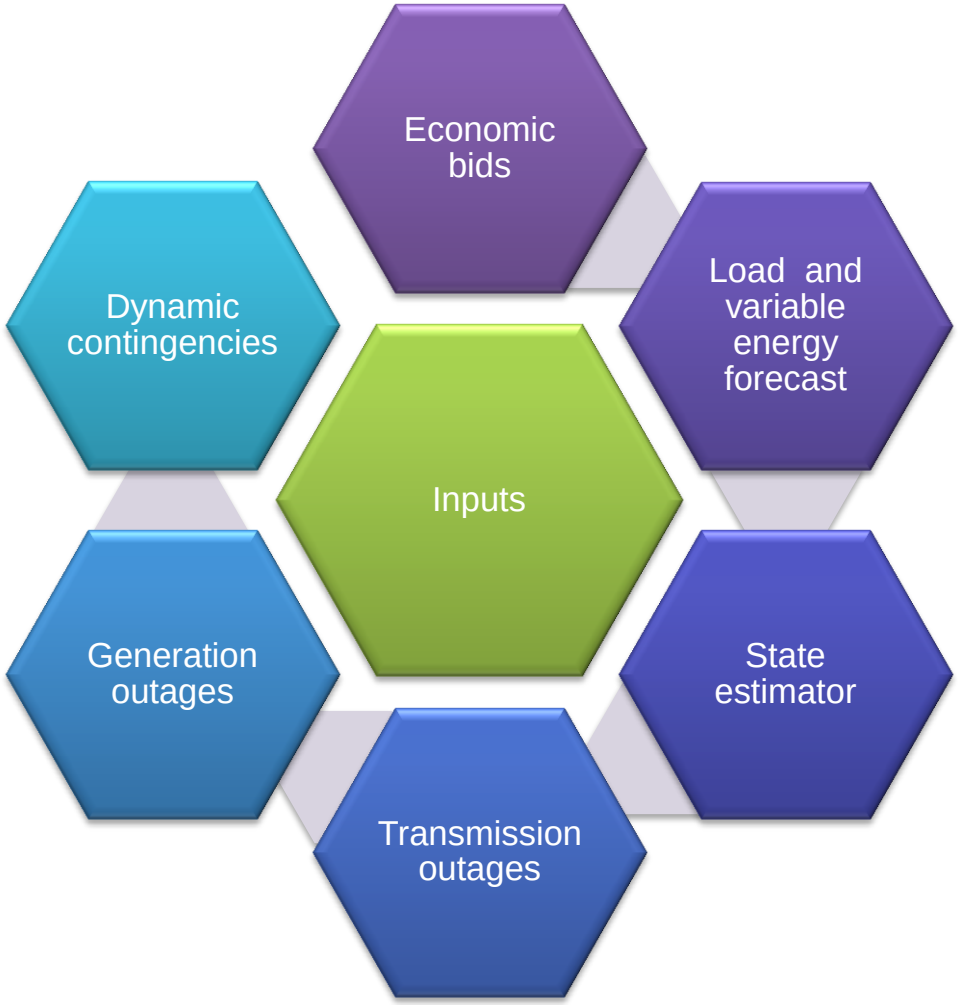


T-7.5

5-minute market produces:

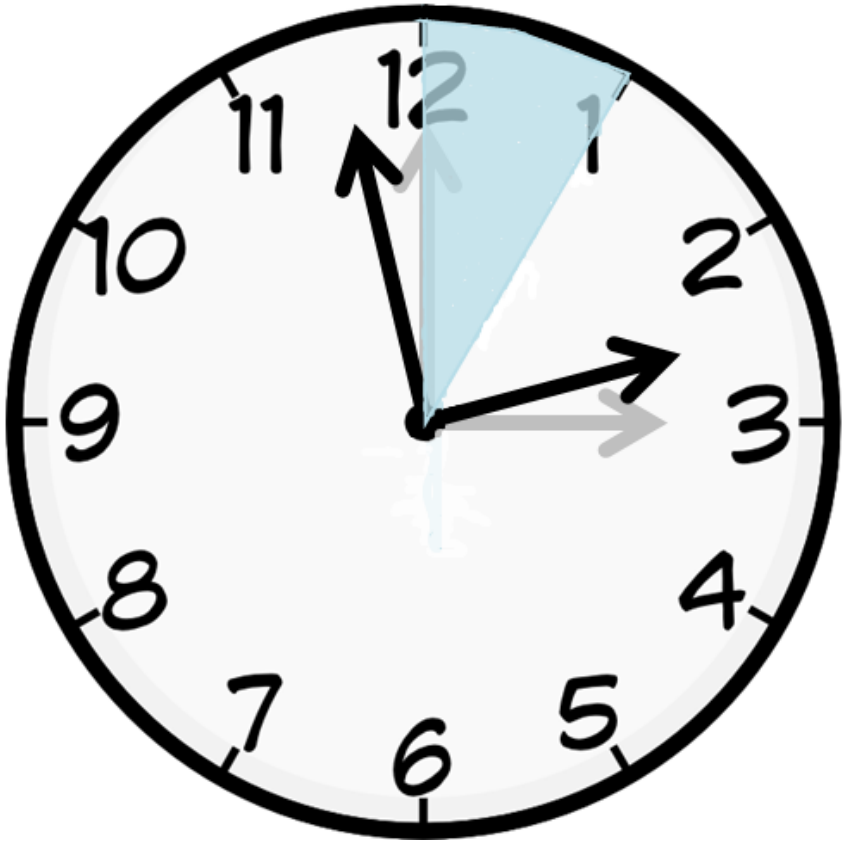
- Dispatch instructions
- 5-minute prices

5 minute dispatch



Generators with accepted bids begin to ramp to the required dispatch point.

Participating resources will receive these instructions via the Automated Dispatch System (ADS).



T-2.5

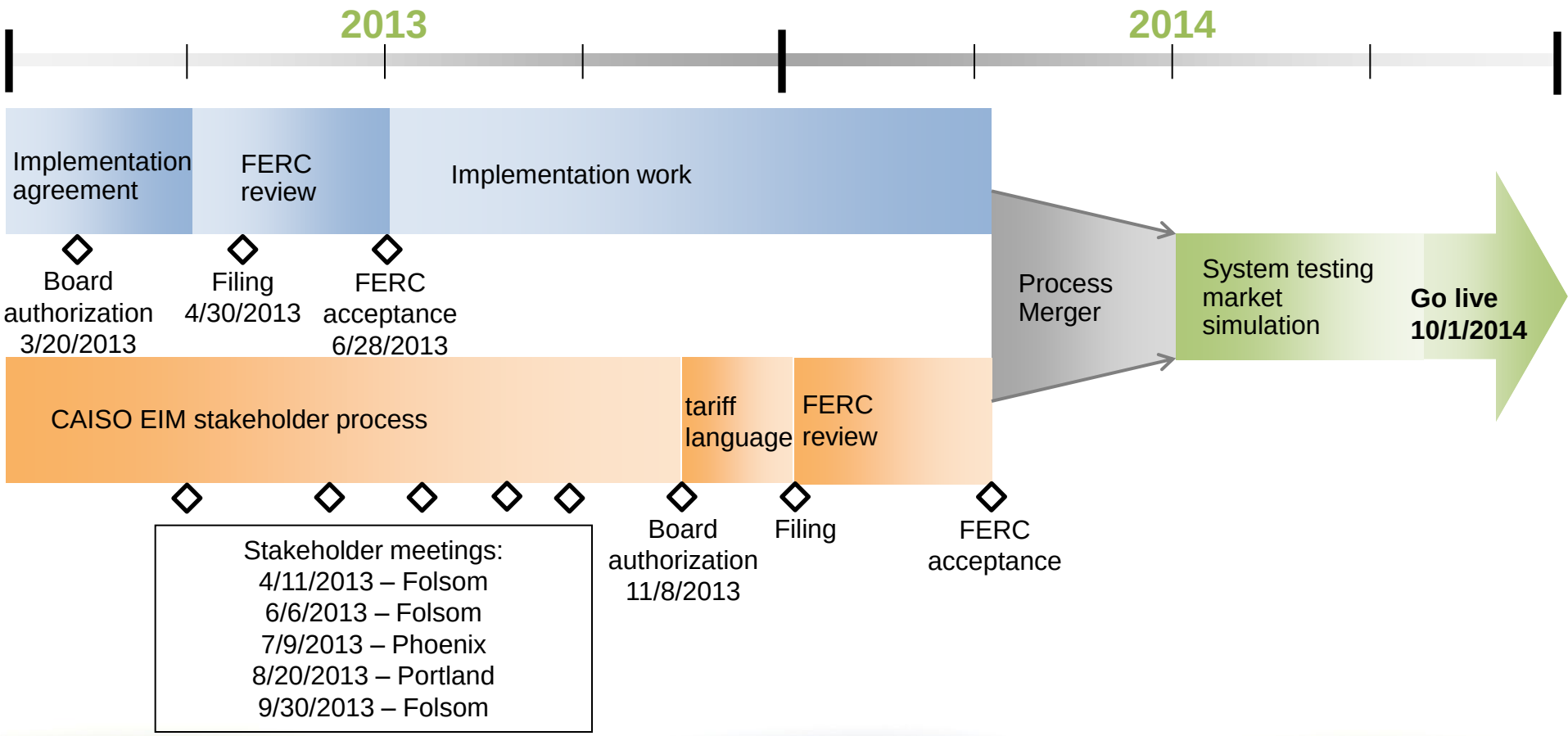
Recap

- EIM processes are running continuously for every 15 minute and 5 minute interval, producing dispatch instructions and prices
- The multi-interval look-ahead allows the ISO to continually refine the forecast and dispatch in the most efficient manner.
- In this way, EIM entities and the ISO get the benefit of increased reliability, improved renewable integration and cost savings.

Implementation timeline

Getting to October 2014

EIM implementation and tariff processes are in progress



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Shaping a Renewed Future

Governance

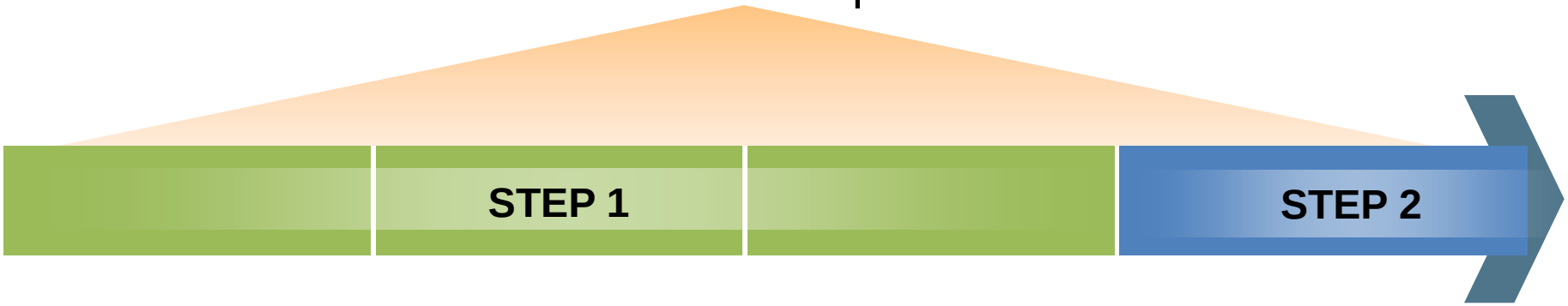
Guiding principles

Guiding objectives for governance drive toward a long-term independent EIM

Prompt & direct input

Adaptable structure

Promote successful implementation



Stakeholder Transition Committee

- Roles: advise on EIM matters, propose independent EIM structure
- Sectors: investor owned utilities, publicly owned utilities, generators and marketers, alternative energy providers, EIM participants, government agencies, public interest entities
- Open meetings, CAISO staff support, no compensation

Independent EIM structure

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EIM administrative fees

How much will it cost?

EIM Administrative Fee is cost-based
(with illustrative example)

EIM Fees	
Sign-up Fee	$0.03 * Net Energy for Load
Volumetric Charge	$0.20/MWh

EIM volumetric charge is based on CAISO Grid Management Charge (GMC), for services used by EIM

Net Annual Energy for Load MWh	One time sign up fee @ $.03/MWh	Assume 10% total deviation (5% load and 5% gen) MWh	Estimated annual cost @ $.20/MWh
25,000,000	$750,000	2,500,000	$500,000

Note: Estimate does not include bid segment fee @ $0.005/bid segment or monthly SCID fee of $1,000/Month

Do you want more information about participating in EIM?

Send all inquiries to:

EIM@caiso.com

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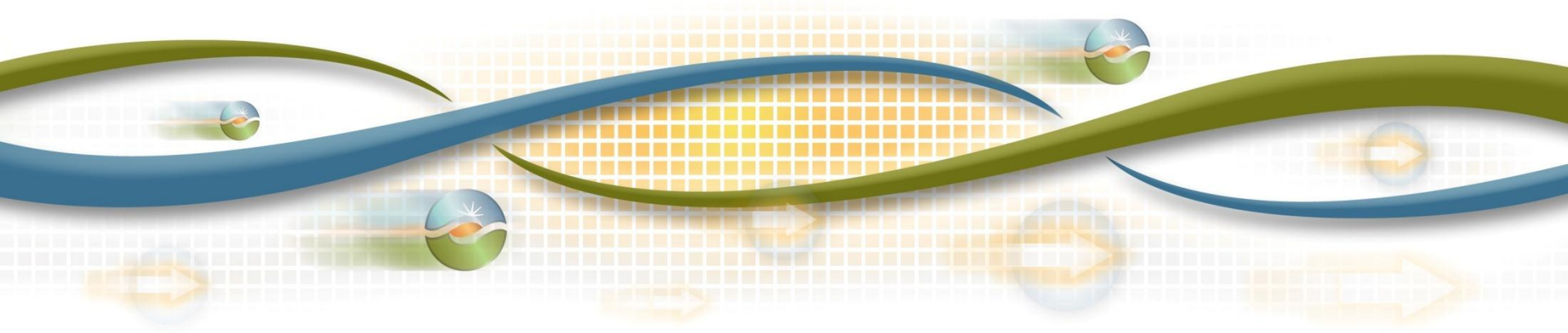
Thank you!



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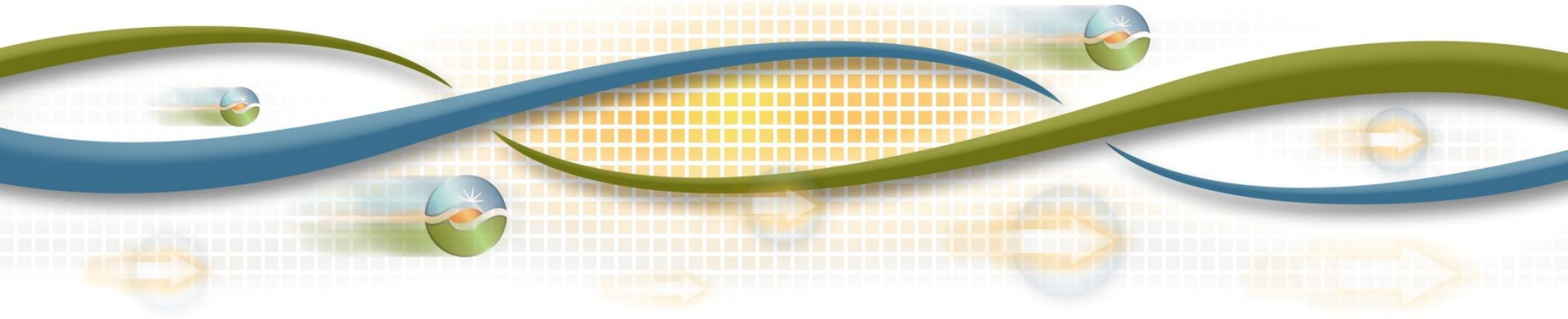
Resources

Where to get more information



Upcoming training opportunities

- **EIM Operations (EIM Module 3)**
  - Instructor-led training covering new procedures for operations personnel; Dates will be announced

- **EIM Back Office (EIM Module 4)**
  - Instructor-led training covering how EIM will affect settlements; Dates will be announced

Other training opportunities

- **Introduction to the Energy Imbalance Market (Module 1)**
- **How the Energy Imbalance Market Works (Module 2)**

  caiso.com>Participate>Training>Markets training>Energy imbalance market (http://www.caiso.com/Documents/Markets%20training%7CEnergy%20imbalance%20market)

  – Computer based training courses that provide a deeper understanding of EIM
- **Welcome to the ISO**
  – Free quarterly webinar that provides a basic understanding of the ISO
- **Introduction to California ISO Markets**
  – Day long instructor-led session that covers the ISO's wholesale energy markets, roles and responsibilities, products and services

More training information

- Training Information – caiso.com>Participate>Training (http://www.caiso.com/participate/Pages/Training/default.aspx)
  - Training Calendar
  - 2014 Course Catalog

- Contact the training department – markettraining@caiso.com

REFERENCES

Links to useful information

References

- California ISO webpage – CAISO.com>Stay informed> Stakeholder processes>Energy imbalance market; http://www.caiso.com/informed/Pages/StakeholderProcesses/EnergyImbalanceMarket.aspx
  - Foundational information
    - Proposal
    - Agreement
    - MOU
  - Benefit Assessments
    - Energy and Environmental Economics, Inc.
    - FERC
  - Market design and tariff development
    - Papers
    - Stakeholder comments

References

- PacifiCorp webpage– Pacificorp.com>About Us>Energy Imbalance Market; http://www.pacificorp.com/about/eim.html
  - Press Release
  - Fact Sheet
  - FAQ
  - Memorandum of Understanding
  - Expected Market Benefits Report

Common acronyms

Acronym	Stands for
ADS	Automated Dispatch System
BA	Balancing Authority
BAA	Balancing Authority Area
BCR	Bid Cost Recovery
BOG	Board of Governors
BPM	Business Practice Manual
CAISO	California Independent System Operator
EIM	Energy Imbalance Market
ESC	EIM Entity Scheduling Coordinator
FERC	Federal Energy Regulatory Commission

Common acronyms

Acronym	Stands for
FMM	15-Minute Market
GMC	Grid Management Charge
HASP	Hour Ahead Scheduling Process
IIE	Instructed Imbalance Energy
ISO	California Independent System Operator
LAP	Load Aggregation Point
LSE	Load Serving Entity
LMP	Locational Marginal Price
LMPM	Local Market Power Mitigation
MO	Market Operator

Common acronyms

Acronym	Stands for
MRI	Market Results Interface
NERC	North American Electric Reliability Corporation
NPR	EIM Non-Participating Resource
OASIS	Open Access Same Time Information System
PR	EIM Participating Resource
PRSC	EIM Participating Resource Scheduling Coordinator
RTD	Real-Time Dispatch
RTED	Real-Time Economic Dispatch
RTM	Real-Time Market
RTPD	Real-Time Pre-Dispatch

Common acronyms

Acronym	Stands for
RTUC	Real-Time Unit Commitment
SC	Scheduling Coordinator
SCED	Security Constrained Economic Dispatch
SCID	Scheduling Coordinator ID
SQMD	Settlement Quality Meter Data
STUC	Short-Term Unit Commitment
UIE	Uninstructed Imbalance Energy
WECC	Western Electricity Coordinating Council

Common acronyms

Acronym	Stands for
ADS	Automated Dispatch System
AGC	Automatic Generation Control
APN	Aggregate Price Node SC Trade
A/S or AS	Ancillary Services
ASMP	Ancillary Services Marginal Price
BA	Balancing Authority
BAA	Balancing Authority Area
BAID	Business Associate Identification
BCR	Bid Cost Recovery
BOG	Board of Governors

Common acronyms

Acronym	Stands for
BPM	Business Practice Manual
BRS	Business Requirements Specification
CARB	California Air Resource Board
CAS	
CAISO	California Independent System Operator
CEC	California Energy Commission
CFCD	California ISO Forecast of California ISO Demand
CMRI	California ISO Market Results Interface
CPUC	California Public Utilities Commission
CRR	Congestion Revenue Rights

Common acronyms

Acronym	Stands for
DA	Day-Ahead
DAM	Day-Ahead Market
DASE	Day-Ahead Scheduled Energy
DEB	Default Energy Bid
DOP	Dispatch Operating Point
DOT	Dispatch Operating Target
DSSE	Day-Ahead Self-Scheduled Energy
EIM	Energy Imbalance Market
EIR	Eligible Intermittent Resource
ESQMD	Estimated Settlement Quality Meter Data

Common acronyms

Acronym	Stands for
FERC	Federal Energy Regulatory Commission
FMM	Fifteen Minute Market
GMC	Grid Management Charge
GRDT	Generator Resource Data Template
HAP	Hour Ahead Process
HASP	Hour Ahead Scheduling Process
IIE	Instructed Imbalance Energy
IFM	Integrated Forward Market
IRDT	Intertie Resource Data Template
ISO	Independent System Operator

Common acronyms

Acronym	Stands for
LAP	Load Aggregation Point
LSE	Load Serving Entity
LMP	Locational Marginal Price
LMPM	Local Market Power Mitigation
MCC	Marginal Cost of Congestion
MCL	Marginal Cost of Losses
MEAF	Metered Energy Adjustment Factor
MLC	Minimum Load Cost
MO	Market Operator
MPM	Market Power Mitigation

Common acronyms

Acronym	Stands for
MRI	Market Results Interface
MW	Megawatt
MWh	Megawatt Hour
NERC	North American Electric Reliability Corporation
OASIS	Open Access Same Time Information System
OE	Optimal Energy
OMAR	Operational Meter Analysis & Reporting
PPT	Pacific Prevailing Time
PIR	Participating Intermittent Resource
PIRP	Participating Intermittent Resource Program

Common acronyms

Acronym	Stands for
RED	Ramping Energy Deviation
REM	Regulation Energy Management
RI-MPR	Renewable Integration – Market & Product Review
RMR	Reliability Must Run
RMT	Regulatory Must Take
RT	Real-Time
RTD	Real-Time Dispatch
RTED	Real-Time Economic Dispatch
RTM	Real-Time Market
RTPD	Real-Time Pre-Dispatch

Common acronyms

Acronym	Stands for
RTUC	Real-Time Unit Commitment
RUC	Residual Unit Commitment
SC	Scheduling Coordinator
SCED	Security Constrained Economic Dispatch
SCID	Scheduling Coordinator ID
SIBR	Scheduling Infrastructure Business Rules (application)
SMEC	System Marginal Cost of Energy
SQMD	Settlement Quality Meter Data
SRE	Standard Ramping Energy
STUC	Short-Term Unit Commitment

Common acronyms

Acronym	Stands for
TG	Tie Generator
TOR	Transmission Ownership Right
UIE	Uninstructed Imbalance Energy
VER	Variable Energy Resource
WECC	Western Electricity Coordinating Council